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# **SCHEME OF INSTRUCTION AND SYLLABUS**

## **B.Tech in Artificial Intelligence and Data Science**

Regulation:VR23

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w.e.f.2023-24



**Department of Computer Science and Engineering**

**VELAGAPUDI RAMAKRISHNA  
SIDDHARTHA ENGINEERING COLLEGE**

(An Autonomous, ISO 9001:2015 Certified Institution)

(Approved by AICTE, Accredited by NAAC with 'A+' Grade,  
Affiliated to JNTUK, Kakinada)

(Sponsored by Siddhartha Academy of General & Technical Education)

Vijayawada, Andhra Pradesh - 520007, INDIA.

[www.vrsiddhartha.ac.in](http://www.vrsiddhartha.ac.in)



## Institute Vision

To nurture excellence in various fields of engineering by imparting timeless core values to the learners and to mould the institution into a centre of academic excellence and advanced research.

## Institute Mission

To impart high quality technical education in order to mould the learners into globally competitive technocrats who are professionally deft, intellectually adept and socially responsible. The institution strives to make the learners inculcate and imbibe pragmatic perception and proactive nature so as to enable them to acquire a vision for exploration and an insight for advanced enquiry.

## Department Vision

The department vision is clearly defined and is in line with the college's vision. The vision of the department is: "To evolve as a centre of academic excellence, advanced research and innovation in the field of Artificial Intelligence and Data Science discipline."

## Department Mission

This mission of the department is concise and supports the college's mission. The mission of the Computer Science and Engineering department is "To inculcate students with profound understanding of fundamentals related to discipline, attitudes, skills, and their application in solving real world problems, with an inclination towards societal issues and research."



## Program Educational Objectives (Undergraduate)

We have program educational objectives for our B.Tech in AI&DS program. Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

Our program educational objectives are:

1. The graduates of the Program will have solid foundation in the principles and practices of computer science, including mathematics, science and basic engineering.
2. The graduates of the Program will have skills to function as members of multi-disciplinary teams and to communicate effectively using modern tools.
3. The graduates of the Program will be prepared for their careers in the software industry or pursue higher studies and continue to develop their professional knowledge.
4. The graduates of the program will practice the profession with ethics, integrity, leadership and social responsibility.



## Program Outcomes

On successful completion of the B.Tech in AI&DS programme the student 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 - *Modern 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 society:*** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7 - *Environment and sustainability:*** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8 - *Ethics:*** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9 - *Individual and team work:*** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10 - *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.

**PO11 - *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.

**PO12 - *Lifelong 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.

## Program Specific Outcomes

**PSO1:** Develop software applications or solutions as per the needs of Industry and society.

**PSO2:** Adopt new and fast emerging technologies in computer science and engineering.

## **COURSE CATEGORY ABBREVIATIONS**

1. Humanities and Sciences-HS
2. Basic Sciences-BS
3. Engineering Science-ES
4. Program Core-PC
5. Soft Skills-SS
6. Skill Enhancement Course-SEC
7. Audit Course-AC
8. Mandatory Course-MC
9. Program Elective-PE
10. Open Elective-OE
11. Humanities and Social Sciences-HSS
12. Advanced Skill Course
13. Institutional Core-IC

# SCHEME OF INSTRUCTION

**DEPARTMENT  
OF  
ARTIFICIAL INTELLIGENCE AND DATA SCIENCE  
SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME  
[VR23]**

***Semester I***

| Contact Hours |             |                 |                                        |    |   |    | 27   |
|---------------|-------------|-----------------|----------------------------------------|----|---|----|------|
| S. No.        | Course Code | Course Category | Course Name                            | L  | T | P  | C    |
| 1             | 23BS1101    | BS              | Linear Algebra & Calculus              | 3  | 0 | 0  | 3    |
| 2             | 23BS1102    | BS              | Engineering Physics                    | 3  | 0 | 0  | 3    |
| 3             | 23ES1103A   | ES              | Basic Civil and Mechanical Engineering | 3  | 0 | 0  | 3    |
| 4             | 23ES1104    | ES              | Introduction to Programming            | 3  | 0 | 0  | 3    |
| 5             | 23HS1105    | HSS             | Communicative English                  | 2  | 0 | 0  | 2    |
| 6             | 23BS1151    | BS              | Engineering Physics Lab                | 0  | 0 | 2  | 1    |
| 7             | 23ES1152    | ES              | Computer Programming Lab               | 0  | 0 | 3  | 1.5  |
| 8             | 23HS1153    | HSS             | Communicative English Lab              | 0  | 0 | 2  | 1    |
| 9             | 23ES1154    | ES              | Engineering Workshop                   | 0  | 0 | 3  | 1.5  |
| 10            | 23ES1155    | ES              | IT Workshop                            | 0  | 0 | 2  | 1    |
| 11            | 23BS1156    | BS              | NSS/NCC/Community Service              | 0  | 0 | 1  | 0.5  |
| 12            | 23MC1106    | MC              | Induction Program                      |    |   |    |      |
| Total         |             |                 |                                        | 14 | 0 | 13 | 20.5 |



***Semester II***

| Contact Hours |             |                 |                                                 |    |   |    | 28   |
|---------------|-------------|-----------------|-------------------------------------------------|----|---|----|------|
| S. No.        | Course Code | Course Category | Course Name                                     | L  | T | P  | C    |
| 1             | 23BS2101    | BS              | Differential Equations<br>Vector Calculus       | 3  | 0 | 0  | 3    |
| 2             | 23BS2102B   | BS              | Chemistry                                       | 3  | 0 | 0  | 3    |
| 3             | 23ES2103B   | ES              | Basic Electrical<br>and Electronics Engineering | 3  | 0 | 0  | 3    |
| 4             | 23PC2104A   | PC              | Data Structures                                 | 3  | 0 | 0  | 3    |
| 5             | 23ES2105    | ES              | Engineering Graphics                            | 1  | 0 | 4  | 3    |
| 6             | 23BS2151B   | BS              | Chemistry Lab                                   | 0  | 0 | 2  | 1    |
| 7             | 23PC2152A   | PC              | Data Structures Lab                             | 0  | 0 | 3  | 1.5  |
| 8             | 23ES2153    | ES              | Basic Electrical<br>and Electronics Workshop    | 0  | 0 | 3  | 1.5  |
| 9             | 23BS2154B   | BS              | Health and wellness,<br>Yoga and Sports         | 0  | 0 | 1  | 0.5  |
| 10            | 23MC2106    | MC              | Introduction to Design Thinking                 | 2  | 0 | 0  | -    |
| Total         |             |                 |                                                 | 15 | 0 | 13 | 19.5 |

**Semester III**

| Contact Hours |             |                 |                                                |    |   |    | 28  |
|---------------|-------------|-----------------|------------------------------------------------|----|---|----|-----|
| S. No.        | Course Code | Course Category | Course Name                                    | L  | T | P  | C   |
| 1             | 23HS3101    | HS              | Engineering Economics & Management             | 2  | 0 | 0  | 2   |
| 2             | 23HS3102    | BSH             | Universal Human Values -Understanding Harmony  | 2  | 1 | 0  | 3   |
| 3             | 23BS3103B   | BS              | Discrete Mathematics                           | 3  | 0 | 0  | 3   |
| 4             | 23ES3304    | ES              | Database Management & Systems                  | 2  | 0 | 2  | 3   |
| 5             | 23AI&DS3305 | PC              | Advanced Data Structures & Algorithms Analysis | 2  | 1 | 0  | 3   |
| 6             | 23AI&DS3307 | PC              | Object Oriented Programming Through Java       | 2  | 1 | 0  | 3   |
| 7             | 23AI&DS3651 | SEC             | Python Programming Lab                         | 0  | 0 | 2  | 1   |
| 8             | 23AI&DS3352 | PC Lab 1        | Advanced Data Structures and Algorithms Lab    | 0  | 0 | 3  | 1.5 |
| 9             | 23AI&DS3353 | PC Lab 2        | Object Oriented Programming Through Java Lab   | 0  | 0 | 3  | 1.5 |
| Total         |             |                 |                                                | 13 | 3 | 12 | 22  |

[L - Lecture, T - Tutorial, P - Practical, C - Credits]

**Semester IV**

| Contact Hours                                                                    |             |                 |                                       |    |   |    | 27  |
|----------------------------------------------------------------------------------|-------------|-----------------|---------------------------------------|----|---|----|-----|
| S. No.                                                                           | Course Code | Course Category | Course Name                           | L  | T | P  | C   |
| 1                                                                                | 23BS4101A   | ES              | Statistical methods for Data Science  | 3  | 0 | 0  | 3   |
| 2                                                                                | 23AI&DS4302 | PC              | Artificial Intelligence               | 3  | 0 | 0  | 3   |
| 3                                                                                | 23AI&DS4303 | PC              | Introduction to Data Science          | 3  | 0 | 0  | 3   |
| 4                                                                                | 23AI&DS4304 | PC              | Digital Logic & Computer Organization | 3  | 0 | 0  | 3   |
| 6                                                                                | 23TP4106    | SS-2            | English For Professionals             | 0  | 0 | 2  | 1   |
| 7                                                                                | 23MC4107    | AC              | Environmental Science                 | 2  | 0 | 0  | -   |
| 8                                                                                | 23AI&DS4651 | SEC             | Full Stack Development-I              | 0  | 0 | 2  | 1   |
| 9                                                                                | 23ES4152    | ES              | Design Thinking & Innovation          | 1  | 0 | 2  | 2   |
| 10                                                                               | 23AI&DS4353 | PC Lab-1        | Artificial Intelligence Lab           | 0  | 0 | 3  | 1.5 |
| 11                                                                               | 23AI&DS4354 | PC Lab-2        | Data Science using Python Lab         | 0  | 0 | 3  | 1.5 |
| Total                                                                            |             |                 |                                       | 15 | 0 | 12 | 19  |
| Summer Internship 6 weeks (Mandatory) during summer vacation (EPICS)             |             |                 |                                       |    |   |    |     |
| Honors/ Minor Courses (the hours distribution can be 3-0-0, 2-0-2 or 2-1-0 also) |             |                 |                                       | 3  | 0 | 0  | 3   |

[L - Lecture, T - Tutorial, P - Practical, C - Credits]

**Semester V**

| Contact Hours                                   |             |                 |                                                                                                                                                                                 |    |   |    | 29 |
|-------------------------------------------------|-------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|---|----|----|
| S. No.                                          | Course Code | Course Category | Course Name                                                                                                                                                                     | L  | T | P  | C  |
| 1                                               | 23AI&DS5301 | PC              | Data Warehousing and Data Mining                                                                                                                                                | 3  | 0 | 0  | 3  |
| 2                                               | 23AI&DS5302 | PC              | Principles of Machine Learning                                                                                                                                                  | 3  | 0 | 0  | 3  |
| 3                                               | 23AI&DS5303 | PC              | Operating Systems                                                                                                                                                               | 3  | 0 | 0  | 3  |
| 4                                               | 23AI&DS5404 | PE I            | A. Software Engineering<br>B. Recommender Systems<br>C. Information Retrieval Systems<br>D. Exploratory Data Analysis with Python                                               | 3  | 0 | 0  | 3  |
| 5                                               | 23AI&DS5205 | OE-I            | A. Web Programming (For Non CSE/IT allied branches only)<br>B. Internet of Things (For Non CSE/IT allied branches only)<br>C. Mobile Application Development (For CSE students) | 3  | 0 | 0  | 3  |
| 6                                               | 23AI&DS5351 | PC Lab - 1      | Data Warehousing and Machine Learning Lab                                                                                                                                       | 0  | 0 | 2  | 1  |
| 7                                               | 23AI&DS5352 | PC Lab - 2      | Operating Systems Lab                                                                                                                                                           | 0  | 0 | 2  | 1  |
| 8                                               | 23AI&DS5653 | SEC             | Full Stack Development -II                                                                                                                                                      | 0  | 0 | 2  | 1  |
| 9                                               | 23AI&DS5554 | EPICS           | Evaluation of Community Service Internship                                                                                                                                      | 0  | 0 | 0  | 2  |
| 8                                               | 23HS5155    | HSS             | Advanced Communication Skills Laboratory                                                                                                                                        | 0  | 0 | 2  | 1  |
| 11                                              | 23ES5156    | ES              | User Interface Design using Flutter / SWAYAM Plus - Android Application Development (with Flutter)                                                                              | 0  | 0 | 2  | 1  |
| 10                                              | 23TP5106    | SS-3            | Personality Development                                                                                                                                                         | 0  | 0 | 2  | 1  |
| 13                                              | 23MC5107A   | AC              | Technical Paper Writing & IPR                                                                                                                                                   | 2  | 0 | 0  | 0  |
| Total                                           |             |                 |                                                                                                                                                                                 | 17 | 0 | 12 | 23 |
| Honors/ Minor Courses (Two Courses in each sem) |             |                 |                                                                                                                                                                                 | 3  | 0 | 0  | 3  |

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Open Elective-I is for the students of Non-CSE/IT allied branches only.

**Semester VI**

| Contact Hours                                                                    |             |                 |                                                                                                                                                                          |    |   |   | 26  |
|----------------------------------------------------------------------------------|-------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|---|---|-----|
| S. No                                                                            | Course Code | Course Category | Course Name                                                                                                                                                              | L  | T | P | C   |
| 1                                                                                | 23AI&DS6301 | PC              | Natural Language Processing & Deep Learning                                                                                                                              | 3  | 0 | 0 | 3   |
| 2                                                                                | 23AI&DS6302 | PC              | Big Data Analytics                                                                                                                                                       | 3  | 0 | 0 | 3   |
| 3                                                                                | 23AI&DS6303 | PC              | Computer Networks                                                                                                                                                        | 3  | 0 | 0 | 3   |
| 4                                                                                | 23AI&DS6404 | PE II           | A.AI for Industrial Applications<br>B. Data Visualization<br>C. Soft Computing<br>D. Computer Vision<br>E. Automata Theory & Compiler Design                             | 3  | 0 | 0 | 3   |
| 5                                                                                | 23AI&DS6405 | PE III          | A. Quantum Computing<br>B. NoSQL databases<br>C. Cloud Computing<br>D. Social Media Analytics<br>E. Any of the 12-Week SWAYAM /NPTEL Course suggested by the BoS         | 3  | 0 | 0 | 3   |
| 6                                                                                | 23AI&DS6206 | OE II (NPTEL)   | 1.Foundations of R Software<br>2.Social Networks<br>3.Introduction to Industry 4.0 and Industrial Internet of Things<br>4.Database Management Systems (other department) | 0  | 0 | 0 | 3   |
| 7                                                                                | 23AI&DS6351 | PC Lab-1        | Natural Language Processing & Deep Learning Lab                                                                                                                          | 0  | 0 | 3 | 1.5 |
| 8                                                                                | 23AI&DS6352 | PC Lab-2        | Big Data Analytics Lab                                                                                                                                                   | 0  | 0 | 3 | 1.5 |
| 9                                                                                | 23TP6107    | SS - 4          | Quantitative Aptitude                                                                                                                                                    | 0  | 0 | 2 | 1   |
| 10                                                                               | 23MC6108A   | AC              | Humanities Elective                                                                                                                                                      | 2  | 0 | 0 | 0   |
| Total                                                                            |             |                 |                                                                                                                                                                          | 20 | 0 | 8 | 22  |
| Honors/ Minor Courses (the hours distribution can be 3-0-0, 2-0-2 or 2-1-0 also) |             |                 |                                                                                                                                                                          | 3  | 0 | 0 | 3   |

[L - Lecture, T - Tutorial, P - Practical, C - Credits]

**Semester VII**

| Contact Hours                                                                |             |                     |                                                                                                                                                                                                                                                                |    |   |   | 25 |
|------------------------------------------------------------------------------|-------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|---|---|----|
| S. No.                                                                       | Course Code | Course Category     | Course Name                                                                                                                                                                                                                                                    | L  | T | P | C  |
| 1                                                                            | 23AI&DS7301 | PC                  | Generative AI                                                                                                                                                                                                                                                  | 3  | 0 | 0 | 3  |
| 2                                                                            | 23HS7102    | MC-II               | Human Resource & Project Management                                                                                                                                                                                                                            | 2  | 0 | 0 | 2  |
| 3                                                                            | 23AI&DS7403 | PE IV               | A. Software Architecture & Design Pattern<br>B. Blockchain Technology<br>C. DevOps<br>D. Architecture for Management of Large Datasets                                                                                                                         | 3  | 0 | 0 | 3  |
| 4                                                                            | 23AI&DS7404 | PE V                | A. Agile Methodologies<br>B. Robotic Process Automation<br>C. Reinforcement Learning<br>D. High Performance Computing                                                                                                                                          | 3  | 0 | 0 | 3  |
| 5                                                                            | 23AI&DS7205 | OE III              | A. Object Oriented Programming Through Java(Other Departments)<br>B. Data Science with Python<br>C. AI Tools and Applications                                                                                                                                  | 3  | 0 | 0 | 3  |
| 6                                                                            | 23AI&DS7206 | OE IV               | A. Programming in Modern C++(MOOCS)<br>B. Ethical Hacking(MOOCS)<br>C. Privacy and Security in Online Social Media(MOOCS)<br>D. Computer Networks (Other Departments)<br>E. Software Engineering (Other Departments)<br>F. 12-Week SWAYAM/NPTEL, MOOCs Courses | 3  | 0 | 0 | 3  |
| 7                                                                            | 23AI&DS7607 | SEC                 | Prompt Engineering                                                                                                                                                                                                                                             | 0  | 1 | 2 | 2  |
| 8                                                                            | 23MC7108    | AC                  | Constitution of India                                                                                                                                                                                                                                          | 2  | 0 | 0 | -  |
| 9                                                                            | 23AI&DS7551 | PC Lab              | Generative AI Lab                                                                                                                                                                                                                                              | 0  | 0 | 2 | 1  |
| 10                                                                           | 23AI&DS7552 | Internship/ Project | Evaluation of Industry Internship / Mini Project                                                                                                                                                                                                               | 0  | 0 | 4 | 2  |
| Total                                                                        |             |                     |                                                                                                                                                                                                                                                                | 19 | 1 | 8 | 22 |
| Industrial/ Research Internship six weeks (Mandatory) during summer vacation |             |                     |                                                                                                                                                                                                                                                                |    |   |   |    |

*L - Lecture, T - Tutorial, P - Practical, C - Credits*

**Note:** Open Elective II and Open Elective IV are self-learning. Students may opt from any MOOCs platforms. They have to submit the certificate before the last instruction day of VII semester. Course selection for MOOCs is subject to approval by the Head of the Department.

## B.Tech in CSE (Artificial Intelligence and Data Science)

### Scheme of Instruction - VR23

#### *Semester VIII*

| Contact Hours |             |                             |                                           |   |   |    | 24 |
|---------------|-------------|-----------------------------|-------------------------------------------|---|---|----|----|
| S. No.        | Course Code | Course Category             | Course Name                               | L | T | P  | C  |
| 1             | 23AI&DS8551 | **Internship & Project Work | Full semester Internship and Project Work | 0 | 0 | 24 | 12 |
| Total         |             |                             |                                           | 0 | 0 | 24 | 12 |

[L - Lecture, T - Tutorial, P - Practical, C - Credits]

**\*\*** The student should undergo internship and simultaneously heshe should work on a project with well-defined objectives. At the end of the semester the student should submit an internship completion certificate and a project report.

**\*\***If any of our associated company comes forward to offer an emerging course that will be offered as an industry offered course in V, VI or VII semesters under program elective with the approval of BoS. This is incorporated to enhance student skills and employability in cutting edge technologies.

#### Open Electives, offered to other department students:

- **Open Elective I:** Operating Systems / Computer Organization and Architecture
- **Open Elective II:** Database Management Systems
- **Open Elective III:** Object Oriented Programming Through Java
- **Open Elective IV:** Computer Networks / Software Engineering / IOT Based Smart Systems / Quantum Science and Technology



# SEMESTER I

## 23BS1101

### LINEAR ALGEBRA & CALCULUS (COMMON TO ALL BRANCHES)

|                 |                        |                   |       |
|-----------------|------------------------|-------------------|-------|
| Course Category | Basic Science          | Credits           | 3     |
| Course Type     | Theory                 | L-T-P             | 3-0-0 |
| Prerequisites   | 10+2 level Mathematics | Continuous Eval   | 30    |
|                 |                        | Semester End Eval | 70    |
|                 |                        | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Solve the system of homogeneous and non-homogeneous linear equations
2. Examine the nature of a quadratic form by transforming into a canonical form
3. Determine maxima and minima of multivariable functions
4. Evaluate areas and volumes using double, triple integrals

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 3  | 2 |   |   | 1 |   |   |   |   |    |    |    |     |   |     |     |
| 2  | 3  | 2 |   |   | 1 |   |   |   |   |    |    |    |     |   |     |     |
| 3  | 3  | 2 |   |   | 1 |   |   |   |   |    |    |    |     |   |     |     |
| 4  | 3  | 2 |   |   | 1 |   |   |   |   |    |    |    |     |   |     |     |

#### COURSE CONTENT

##### UNIT I-Matrices

Rank of a matrix by Echelon form, Normal form, Cauchy–Binet formulae (without proof), Inverse of Non- singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss-Seidel Iteration Methods.

##### UNIT II-Eigenvalues, Eigenvectors and Orthogonal Transformation

Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), Finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic forms, Reduction of Quadratic form to Canonical forms by Orthogonal Transformation.

##### UNIT III-Differential Calculus

**Mean Value Theorems:** Rolle's theorem, Lagrange's mean value theorem with

their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof), Problems and applications on the above theorems.

**Functions of Several Variables:** Continuity and Differentiability, Partial derivatives, Total derivatives, Chain rule, Directional derivative, Taylor's and Maclaurin's series expansion of functions of two variables, Jacobians, Functional dependence, Maxima and Minima of functions of two variables, Method of Lagrange multipliers.

#### **UNIT IV-Multiple Integrals (Multivariable Calculus)**

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).

#### **TEXT BOOKS**

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition

#### **REFERENCE BOOKS**

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley Sons, 2018, 10th Edition.
2. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint)
4. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition
5. Advanced Engineering Mathematics, Michael Greenberg, Pearson publishers, 9th Edition
6. Higher Engineering Mathematics, H. K. Das, Er. Rajnish Verma, S. Chand Publications, 2014, 3rd Edition (Reprint 2021)

#### **E-RESOURCES AND OTHER DIGITAL MATERIALS:**

1. Prof. S. K. Gupta & Prof. Sanjeev Kumar, IIT Roorkee, Matrix Analysis with Applications [English], Available: [https://onlinecourses.nptel.ac.in/noc19\\_ma28/preview](https://onlinecourses.nptel.ac.in/noc19_ma28/preview)
2. Prof. Jitendra Kumar, IIT Kharagpur, Engineering Mathematics – I [English], Available: [https://onlinecourses.nptel.ac.in/noc20\\_ma37/preview](https://onlinecourses.nptel.ac.in/noc20_ma37/preview)
3. Prof. Jitendra Kumar & Prof. Somesh Kumar, IIT Kharagpur, Advanced Calculus For Engineers [English], Available: [https://onlinecourses.nptel.ac.in/noc22\\_ma75/preview](https://onlinecourses.nptel.ac.in/noc22_ma75/preview)
4. Prof. Denis Auroux, Massachusetts Institute of Technology: MIT Open Courseware, Multivariable Calculus, Available: <https://ocw.mit.edu>.

## 23BS1102

### ENGINEERING PHYSICS

(Common to all Programmes)

|                 |                    |                   |       |
|-----------------|--------------------|-------------------|-------|
| Course Category | Institutional Core | Credits           | 3     |
| Course Type     | Theory             | L-T-P             | 3-0-0 |
| Prerequisites   | -                  | Continuous Eval   | 30    |
|                 |                    | Semester End Eval | 70    |
|                 |                    | Total Marks       | 100   |

#### COURSE OBJECTIVES:

To bridge the gap between the Physics in school at 10+2 level and UG level engineering courses by identifying the importance of the modern optical devices such as Lasers and optical fibers, enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

#### COURSE OUTCOMES

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

1. Elaborate different types of lasers, optical fibers and their applications
2. Familiarize with the basics of crystals and their structures
3. Summarize various types of polarization of dielectrics and classify the magnetic materials
4. Explain the basic concepts of Quantum Mechanics and types of semiconductors using Hall Effect.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 3  | 1 |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 2  | 3  | 2 |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 3  | 3  |   |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 4  | 3  |   |   |   |   |   |   |   |   |    |    |    |     |   |     |     |

#### COURSE CONTENT

##### UNIT I-Lasers and Fiber Optics

**Lasers:** Introduction, Characteristics of laser, Basic Principles of lasers (absorption, spontaneous emission and stimulated emission), Requirements of lasers (pumping, population inversion and cavity resonance), Einstein's coefficients, different types of lasers: solid-state lasers (Ruby), gas lasers, (He-Ne), Semiconductor laser, applications of lasers in science, engineering and medicine.

**Fibre Optics:** Introduction, Fundamentals of optic fibre, Propagation of light through optical fiber, Types of optical fibers, Numerical aperture, Fractional Refractive Index change, Fiber optics in communication and its advantages.

### UNIT II-Crystallography and X-ray diffraction

**Crystallography:** Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC FCC - Miller indices – separation between successive (hkl) planes.

**X-ray diffraction:** Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods.

### UNIT III-Dielectric and Magnetic Materials

**Dielectric Materials:** Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius-Mossotti equation - Frequency dependence of polarization – complex dielectric constant (Qualitative) – dielectric loss (Qualitative).

**Magnetic Materials:** Introduction - Magnetic dipole moment - Magnetization- Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, Para and Ferro magnetic materials - Domain concept for Ferromagnetism Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

### UNIT IV-Quantum Mechanics and Semiconductors

**Quantum Mechanics:** Dual nature of light, Matter waves, Properties and De-broglie's hypothesis, G.P.Thomson experiment, Heisenberg's Uncertainty Principle and its applications (Non existence of electron in nucleus) and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

**Semiconductors:** Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors- Fermi level-Extrinsic semiconductors-Fermi level - Drift and diffusion currents – Einstein's equation – Hall effect and its applications, Photodiode, Light Emitting Diode, Solar cell and its applications.

### TEXT BOOKS

1. A Text book of Engineering Physics, M. N. Avadhanulu, P.G.Kshirsagar TVS Arun Murthy, S. Chand Publications, 11th Edition 2019.
2. Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)

### REFERENCE BOOKS

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021
2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.

3. Engineering Physics - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press. 2010
4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009)

**E-RESOURCES AND OTHER DIGITAL MATERIALS:**

1. <https://www.loc.gov/rr/scitech/selected-internet/physics.html>

## 23ES1103A

### BASICS OF CIVIL & MECHANICAL ENGINEERING

|                 |                    |                   |       |
|-----------------|--------------------|-------------------|-------|
| Course Category | Institutional Core | Credits           | 3     |
| Course Type     | Theory             | L-T-P             | 3-0-0 |
| Prerequisites   | 10+2               | Continuous Eval   | 30    |
|                 |                    | Semester End Eval | 70    |
|                 |                    | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Understand various Civil Engineering sub-divisions thereby appreciate their role in ensuring a better society and understand the basic building components along with attaining knowledge of Civil Engineering Materials and prefabricated technology
2. Know the basic concepts, uses and classification of surveying and realize the importance of Transportation in the nation's economy and the engineering measures related to Transportation and understand the importance of Water Storage and Conveyance Structures so that the social responsibilities of water conservation will be appreciated
3. Understand the scope of Mechanical Engineering in different sectors and industries and know about different manufacturing processes
4. Explain the basics of thermal engineering, Power plants , power transmission and robotics

***Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)***

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 2  |   |   |   | 1 | 3 | 2 |   |   |    |    |    |     |   |     |     |
| 2  | 1  |   |   |   | 2 | 2 | 3 |   |   |    |    |    |     |   |     |     |
| 3  | 2  |   |   |   | 1 | 2 | 3 |   |   |    |    |    |     |   |     |     |
| 4  | 2  |   |   |   | 1 | 2 | 3 |   |   |    |    |    |     |   |     |     |

#### COURSE CONTENT

##### UNIT I

***Basics of Civil Engineering:*** Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental

Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel-Introduction to Prefabricated Construction Techniques.

## UNIT II

**Surveying and Transportation Engineering:** Objectives of Surveying- Principles of Surveying-Classification based on function and instruments, Importance of Transportation in Nation's Economic Development- Basics components of Road-Classification of Highways.

**Water Resources and Environmental Engineering:** Introduction, Sources of water- Quality of water- Specifications- Simple introduction to Dams and Reservoirs.

## UNIT III

**Introduction to Mechanical Engineering:** Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors. Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

**Manufacturing Processes:** Principles of Casting, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

## UNIT IV

**Thermal Engineering:** IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Otto cycle,Diesel cycle,Components of Electric and Hybrid Vehicles., Refrigeration and air conditioning Working principle of Boilers: classification of Boilers Power plants – Working principle of Steam, Nuclear power plants. Mechanical Power Transmission - Belt and Gear Drives, Introduction to Robotics.

## TEXT BOOKS

1. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition. (UNITS I & II)
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition (UNITS I & II)
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition (UNITS I & II)
4. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd. (UNITS III & IV)
5. A text book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd. (UNITS III & IV)
6. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd. (UNITS III & IV)

## REFERENCE BOOKS

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019.



- Fifth Edition. (UNITS I & II)
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016. (UNITS I & II)
  3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38th Edition. (UNITS I & II)
  4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition. (UNITS I & II)
  5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012 (UNITS I & II)
  6. Advances in Civil Engineering (Volume - 5), S. Sathish, AkiNik Publications, 2021. (UNITS I & II)
  7. Advances in Civil Engineering (Volume - 5), S. Sathish, AkiNik Publications, 2021. (UNITS I & II)
  8. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata McGraw Hill publications (India) Pvt. Ltd. (UNITS III & IV)
  9. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt. Ltd. (UNITS III & IV)
  10. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications. (UNITS III & IV)
  11. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I. (UNITS III & IV)

#### **E-RESOURCES AND OTHER DIGITAL MATERIALS:**

1. <http://nptel.iitm.ac.in/video.php?subjectId=10810607>
2. <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm>
3. <http://www.mike-willis.com/Tutorial/PF2.htm>
4. <https://www.scribd.com/document/680441639/Basic-Civil-and-Mechanical-Engineering>
5. <https://www.imeche.org/careers-education/careers-information/what-is-mechanical-engineering/where-do-mechanical-engineers-work>

## 23ES1104

### Introduction To Programming (Common to All Branches)

|                 |                     |                   |       |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits           | 3     |
| Theory          | Theory              | L-T-P             | 3-0-0 |
| Prerequisites   | –                   | Continuous Eval   | 30    |
|                 |                     | Semester End Eval | 70    |
|                 |                     | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. To introduce students to the fundamentals of computer programming
2. To provide hands-on experience with coding and debugging on control structures and arrays
3. To foster logical thinking and problem-solving skills on strings and pointers
4. To familiarize students with programming concepts such as functions, structures and files

***Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)***

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 3  | 1 |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 2  |    | 2 | 3 |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 3  |    | 2 | 3 |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 4  |    | 2 | 3 |   |   |   |   |   |   |    |    |    |     |   |     |     |

#### COURSE CONTENT

##### UNIT I- Introduction to Programming and Problem Solving

**History of Computers, Basic organization of a computer:** ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program- Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting.

***Problem solving techniques:*** Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

##### UNIT II-Control Structures and Arrays

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for,

while, do- while) Break and Continue, Arrays indexing, memory model, programs with array of integers, two dimensional arrays.

### **UNIT III-Strings and pointers**

Introduction to Strings. Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers.

### **UNIT IV-Functions, User Defined Data types and File Handling**

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, User-defined data types-Structures and Unions, Basics of File Handling

### **TEXT BOOKS**

1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice- Hall, 1988
2. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education, 1996.

### **REFERENCE BOOKS**

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.W. H. Hayt and J. A. Buck, "Engineering Electromagnetics", 7th edition, Tata McGraw Hill, New Delhi, 2006.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition.
3. C Programming,A Problem Solving Approach,Forouzan,Gilberg,Prasad, CEN-GAGE, 3rd edition.

### **E-RESOURCES AND OTHER DIGITAL MATERIALS:**

1. <http://nptel.iitm.ac.in/video.php?subjectId=10810607>
2. <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm>
3. <http://www.mike-willis.com/Tutorial/PF2.htm>

## 23HS1105

### COMMUNICATIVE ENGLISH

|                 |                                                                                                                                    |                                                     |                 |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------|
| Course Category | Institutional Core/<br>Humanities and<br>Social Science                                                                            | Credits                                             | 2               |
| Theory          | Theory                                                                                                                             | L-T-P                                               | 2-0-0           |
| Prerequisites   | Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities | Continuous Eval<br>Semester End Eval<br>Total Marks | 30<br>70<br>100 |

#### COURSE OUTCOMES

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

1. Understand the context, topic, and pieces of specific information from social or Transactional dialogues
2. Apply grammatical structures to formulate sentences and correct word forms
3. Analyze discourse markers to speak clearly on a specific topic in informal discussions
4. Evaluate reading texts / listening to write summaries based on global comprehension and create a coherent paragraph, essay and résumé

***Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)***

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 2  |   |   |   |   |   |   |   |   | 3  |    | 2  |     |   |     |     |
| 2  | 2  | 2 |   |   |   |   |   |   |   | 3  |    | 2  |     |   |     |     |
| 3  | 2  |   |   |   |   |   |   |   |   | 3  |    | 2  |     |   |     |     |
| 4  | 2  | 2 |   |   |   |   |   |   |   | 3  |    | 2  |     |   |     |     |

#### COURSE CONTENT UNIT I

***Lesson: HUMAN VALUES: Gift of Magi (Short Story)***

***Listening:*** Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.

***Speaking:*** Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

***Reading:*** Skimming to get the main idea of a text; scanning to look for specific pieces of information.

**Writing:** Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.

**Grammar:** Parts of Speech, Basic Sentence Structures-forming questions.

**Vocabulary:** Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

## UNIT II

**Lesson: NATURE: The Brook by Alfred Tennyson (Poem)**

**Listening:** Answering a series of questions about main ideas and supporting ideas after listening to audio texts.

**Speaking:** Discussion in pairs/small groups on specific topics followed by short structure talks.

**Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

**Writing:** Structure of a paragraph - Paragraph writing (specific topics).

**Grammar:** Cohesive devices - linkers, use of articles and zero article; prepositions.

**Vocabulary:** Homonyms, Homophones, Homographs.

## UNIT III

**Lesson: BIOGRAPHY: Elon Musk**

**Listening:** Listening for global comprehension and summarizing what is listened to.

**Speaking:** Discussing specific topics in pairs or small groups and reporting what is discussed.

**Reading:** Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

**Writing:** Summarizing, Note-making, paraphrasing, Essay Writing, (The Power of Intrapersonal Communication).

**Grammar:** Verbs - tenses; subject-verb agreement; Compound words, Collocations.

**Vocabulary:** Compound words, Collocations.

## UNIT IV

**Lesson: INSPIRATION: The Toys of Peace by Saki**

**Listening:** Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

**Speaking:** Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

**Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.

**Writing:** Letter Writing: Official Letters, Resumes & Report Writing.

**Grammar:** Reporting verbs, Direct & Indirect speech, Active & Passive Voice.

**Vocabulary:** Words often confused, Jargons & Technical Jargons.

**TEXT BOOKS**

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023 (Units 1,2 & 3)
2. Empowering with Language by Cengage Publications, 2023 (Units 4 & 5).
3. English: Language, Context and Culture, 1st Edition, Orient Black Swan, 2023 (Units5)

**REFERENCE BOOKS**

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020.
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

**E-RESOURCES AND OTHER DIGITAL MATERIALS:****GRAMMAR**

1. [www.bbc.co.uk/learningenglish](http://www.bbc.co.uk/learningenglish)
2. <https://dictionary.cambridge.org/grammar/british-grammar/>
3. [www.eslpod.com/index.html](http://www.eslpod.com/index.html)
4. <https://www.learngrammar.net/>
5. <https://english4today.com/english-grammar-online-with-quizzes/>
6. <https://www.talkenglish.com/grammar/grammar.aspx>

**VOCABULARY**

1. <https://www.youtube.com/c/DailyVideoVocabulary/videos>
2. [https://www.youtube.com/channel/UC4cmBAit8i\\_NJZE8qK8sfpA](https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA)

## 23BS1151

### ENGINEERING PHYSICS LAB

(Common to All Branches)

|                 |                                       |                   |       |
|-----------------|---------------------------------------|-------------------|-------|
| Course Category | Institutional Core/<br>Basic Sciences | Credits           | 1     |
| Theory          | Lab                                   | L-T-P             | 0-0-2 |
| Prerequisites   | –                                     | Continuous Eval   | 30    |
|                 |                                       | Semester End Eval | 70    |
|                 |                                       | Total Marks       | 100   |

### COURSE OUTCOMES

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

1. Test optical components using principles of interference and diffraction of light
2. Use spectrometer, travelling microscope and function generator in various experiments
3. Determine the V-I characteristics of photo cells and appreciate the accuracy in measurements

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  |    |   |   | 3 |   |   |   |   |   |    |    |    |     |   |     |     |
| 2  |    |   |   | 3 |   |   |   |   |   |    |    |    |     |   |     |     |
| 3  | 2  |   |   | 3 |   |   |   |   |   |    |    |    |     |   |     |     |

### COURSE CONTENT

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
3. Determination of wavelength of Laser light using diffraction grating
4. Estimation of stopping potential and work function of a photo material using photoelectric effect. 4. Estimation of stopping potential and work function of a photo material using photoelectric effect.
5. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
6. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect.

7. Determination of Acceleration due to Gravity and radius of Gyration by using a compound pendulum.
8. Sonometer: Verification of laws of stretched string.
9. Determination of Dielectric constant of different solid materials.
10. Determination of Numerical Aperture of a given optical fiber.
11. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.
12. Determination of Rigidity Modulus of the material of the given wire using Torsional pendulum.
13. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
14. Determination of Energy Gap of a semiconductor using p-n junction diode.
15. Determination of thickness of a thin foil by Wedge Method.
16. Estimation of Fill Factor of a given Solar Cell.
17. Study the frequency response and determination of resonating frequency of LCR Circuit.
18. Determination of Figure of merit of a Galvanometer.

- **Note:** Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

### TEXT BOOKS

1. Madhusudhan Rao, "Engineering Physics Lab Manual", 1st ed., Scitech Publications, 2015.
2. Ramarao Sri, Choudary Nityanand and Prasad Daruka, "Lab Manual of Engineering Physics", Vth ed., Excell Books, 2010.

### E-RESOURCES

1. <http://plato.stanford.edu/entries/physics-experiment>
2. <http://www.physicsclassroom.com/The-Laboratory>
3. <http://facstaff.cbu.edu/~jvarrian/physlabs.html>.

### VIRTUAL LAB REFERENCES

1. <http://vlab.amrita.edu/?sub=1&brch=201&sim=366&cnt=1>
2. <http://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1>
3. <http://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1>



## 23ES1152

### COMPUTER PROGRAMMING LAB

(Common to All Branches)

|                 |                     |                   |       |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits           | 1     |
| Theory          | Lab                 | L-T-P             | 0-0-2 |
| Prerequisites   | –                   | Continuous Eval   | 30    |
|                 |                     | Semester End Eval | 70    |
|                 |                     | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Read, understand, and trace the execution of programs written in C language
2. Select the right control structure for solving the problem
3. Develop C programs which utilize memory efficiently using programming constructs like pointers
4. Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 3  | 1 |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 2  |    | 2 | 3 |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 3  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 4  |    | 2 | 3 |   |   |   |   |   |   |    |    |    |     |   |     |     |

#### COURSE CONTENT

##### UNIT I

##### Week 1

**Objective:** Getting familiar with the programming environment on the computer and writing the first program.

**Suggested Experiments/Activities:**

**Tutorial 1:** Problem-solving using Computers.

**Lab1:** Familiarization with programming environment.

- i. Basic Linux environment and its editors like Vi, Vim & Emacs etc.
- ii. Exposure to Turbo C, gcc
- iii. Writing simple programs using printf(), scanf()

**Week 2**

**Objective:** Getting familiar with how to formally describe a solution to a problem in a series of finite steps both using textual notation and graphic notation.

**Suggested Experiments/Activities:**

**Tutorial 2:** Problem-solving using Algorithms and Flow charts.

**Lab2:** Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

- i. Sum and average of 3 numbers.
- ii. Conversion of Fahrenheit to Celsius and vice versa
- iii. Simple interest calculation

**Week 3**

**Objective:** Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

**Suggested Experiments/Activities:**

**Tutorial 3:** Variable types and type conversions.

**Lab3:** Simple computational problems using arithmetic expressions.

- i. Finding the square root of a given number
- ii. Finding compound interest
- iii. Area of a triangle using heron's formulae
- iv. Distance travelled by an object

**Unit II****Week 4**

**Objective:** Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.

**Suggested Experiments/Activities:**

**Tutorial 4:** Operators and the precedence and as associativity.

**Lab4:** Simple computational problems using the operator' precedence and associativity.

- i. Evaluate the following expressions
  - (a)  $A+B*C+(D*E) + F*G$
  - (b)  $A/B*C-B+A*D/3$
  - (c)  $A++++B-A$
  - (d)  $J= (i++) + (++i)$
- ii. Find the maximum of three numbers using conditional operator
- iii. Take marks of 5 subjects in integers, and find the total, average in float

**Week 5**

**Objective:** Explore the full scope of different variants of “if construct” namely if-else, null- else, if-else if\*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for “if construct”.

***Suggested Experiments/Activities:******Tutorial 5:*** Branching and logical expressions***Lab5:*** Problems involving if-then-else structures.

- i. Write a C program to find the max and min of four numbers using if-else
- ii. Write a C program to generate electricity bill
- iii. Find the roots of the quadratic equation
- iv. Write a C program to simulate a calculator using switch case
- v. Write a C program to find the given year is a leap year or not

**Week 6**

***Objective:*** Explore the full scope of iterative constructs namely while loop, do-while loop and loop in addition to structured jump constructs like break and continue including when each of these statements is more appropriate to use.

***Suggested Experiments/Activities:******Tutorial 6:*** Loops, while and for loops***Lab6:*** Iterative problems e.g., the sum of series

- i. Find the factorial of given number using any loop
- ii. Find the given number is a prime or not
- iii. Compute sine and cos series
- iv. Checking a number palindrome
- v. Construct a pyramid of numbers

**Unit III****Week 7**

***Objective:*** Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

***Suggested Experiments/Activities:******Tutorial 7:*** 1 D Arrays: searching.***Lab7:*** 1D Array manipulation, linear search.

- i. Find the min and max of a 1-D integer array
- ii. Perform linear search on 1D array
- iii. The reverse of a 1D integer array
- iv. Find 2's complement of the given binary number
- v. Eliminate duplicate elements in an array

**Week 8**

***Objective:*** Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

***Suggested Experiments/Activities:******Tutorial 8:*** 2 D arrays, sorting and Strings.***Lab8:*** Matrix problems, String operations, Bubble sort.

- i. Addition of two matrices
- ii. Multiplication two matrices
- iii. Sort array elements using bubble sort
- iv. Concatenate two strings without built-in functions
- v. Reverse a string using built-in and without built-in string functions

## Unit IV

### Week 9

**Objective:** Explore pointers to manage a dynamic array of integers, including memory allocation and; value initialization, resizing changing and reordering the contents of an array memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C.

**Suggested Experiments/Activities:**

**Tutorial 9:** Pointers, structures and dynamic memory allocation.

**Lab9:** Pointers and structures, memory dereference.

- i. Write a C program to find the sum of a 1D array using malloc()
- ii. Write a C program to find the total, average of n students using structures
- iii. Enter n students data using calloc() and display failed students list
- iv. Read student name and marks from the command line and display the student details along with the total
- v. Write a C program to implement realloc()

### Week 10

**Objective:** Experiment with C Structures, Unions, bit fields and self-referential structures (Singly linked lists) and nested structures.

**Suggested Experiments/Activities:**

**Tutorial 10:** Bitfields, Self-Referential Structures, Linked lists

**Lab10:** Bitfields, linked lists

Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields

- i. Create and display a singly linked list using self-referential structure
- ii. Demonstrate the differences between structures and unions using a C program
- iii. Write a C program to shift/rotate using bitfields
- iv. Write a C program to copy one structure variable to another structure of the same type

## Unit V

### Week 11

**Objective:** Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration.

**Suggested Experiments/Activities:**

**Tutorial 11:** Functions, call by value, scope and extent

**Lab11:** Simple functions using call by value, solving differential equations using Eulers theorem

- i. Write a C function to calculate NCR value
- ii. Write a C function to find the length of a string
- iii. Write a C function to transpose of a matrix
- iv. Write a C function to demonstrate numerical integration of differential equations using Euler's method

**Week 12**

**Objective:** Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

**Suggested Experiments/Activities:**

**Tutorial 12:** Recursion, the structure of recursive calls

**Lab12:** Recursive functions

- i. Write a recursive function to generate Fibonacci series
- ii. Write a recursive function to find the lcm of two numbers
- iii. Write a recursive function to find the factorial of a number
- iv. Write a C Program to implement Ackermann function using recursion
- v. Write a recursive function to find the sum of series

**Week 13**

**Objective:** Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers.

**Suggested Experiments/Activities:**

**Tutorial 13:** Call by reference, dangling pointers

**Lab13:** Simple functions using Call by reference, Dangling pointers

- i. Write a C program to swap two numbers using call by reference
- ii. Demonstrate Dangling pointer problem using a C program
- iii. Write a C program to copy one string into another using pointer
- iv. Write a C program to find no of lowercase, uppercase, digits and other characters using pointers

**Week 14**

**Objective:** To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files.

**Suggested Experiments/Activities:**

**Tutorial 14:** File handling

**Lab14:** File operations

- i. Write a C program to write and read text into a file
- ii. Write a C program to write and read text into a binary file using fread() and fwrite()
- iii. Copy the contents of one file to another file
- iv. Write a C program to merge two files into the third file using command-line arguments
- v. Find no. of lines, words and characters in a file
- vi. Write a C program to print last n characters of a given file

### **TEXT BOOKS**

1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw Hill.

### **E-RESOURCES**

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice- Hall of India
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

## 23HS1153/23HS2153

### Communicative English Lab

#### (Common to All Branches)

|                 |                                                                                                                                     |                                                     |                 |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------|
| Course Category | Institutional Core                                                                                                                  | Credits                                             | 1               |
| Theory          | Practical                                                                                                                           | L-T-P                                               | 0-0-2           |
| Prerequisites   | Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities. | Continuous Eval<br>Semester End Eval<br>Total Marks | 30<br>70<br>100 |

### COURSE OUTCOMES

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

1. Understand the different aspects of the English language proficiency with emphasis on LSRW skills
2. Apply communication skills through various language learning activities
3. Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension
4. Evaluate and exhibit professionalism in participating in debates and group discussions

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  |    | 2 |   |   |   |   |   |   |   | 3  |    | 2  |     |   |     |     |
| 2  |    |   |   |   |   |   |   |   |   | 3  |    | 2  |     |   |     |     |
| 3  |    |   |   |   |   |   |   |   |   | 3  |    | 2  |     |   |     |     |
| 4  |    |   |   |   |   |   |   |   |   | 3  |    | 2  |     |   |     |     |

### COURSE CONTENT

#### List of Topics

1. Vowels and Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing
6. Resume Writing, Cover Letter, SOP
7. Group Discussions-methods & practice

8. Debates – Methods & Practice
9. PPT Presentations/Poster Presentations
10. Interview Skills

**SUGGESTED SOFTWARE**

1. WALDEN
2. SOFTX
3. VISIONET



## 23ES1154

### ENGINEERING WORKSHOP

|                 |                      |                   |       |
|-----------------|----------------------|-------------------|-------|
| Course Category | Engineering Sciences | Credits           | 1.5   |
| Theory          | Laboratory           | L-T-P             | 0-0-3 |
| Prerequisites   | –                    | Continuous Eval   | 30    |
|                 |                      | Semester End Eval | 70    |
|                 |                      | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Understand the basic joints using wood and familiarize with various fundamental aspects of house wiring, fitting and foundry.
2. Prepare basic models using sheet metal and practice joining of metals using various types of welding.
3. Familiarize with various advanced manufacturing processes such as injection moulding and 3D printing.
4. Understand the preparation of PCB and simple IOT applications using Arduino.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  |    |   | 2 |   | 3 |   |   |   |   |    |    |    |     |   |     |     |
| 1  |    |   | 2 |   | 3 |   |   |   |   |    |    |    |     |   |     |     |
| 2  |    |   | 2 |   | 3 |   |   |   |   |    |    |    |     |   |     |     |
| 3  |    |   | 2 |   | 1 |   |   |   |   |    |    |    |     |   |     |     |

#### COURSE CONTENT

##### PART-A

1. **Demonstration:** Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints. **(2 classes)**
  - (a) Half-Lap joint
  - (b) Bridle joint
  - (c) Demonstration of power tools.
3. **Sheet Metal Working:** Familiarity with different types of tools used in sheet metal working, developmentsof following sheet metal job from GI sheets. **(2 classes)**

- (a) Tapered tray
- (b) Conical funnel
- 4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises. (**2 classes**)
  - (a) V-fit
  - (b) Semi-circular fit
  - (c) Bicycle tire puncture and change of two-wheeler tyre
- 5. **Electrical Wiring:** Familiarity with different types of basic electrical circuits and make the following connections. (**1 class**)
  - (a) Parallel and series
  - (b) Two-way switch
  - (c) Godown lighting
  - (d) Tube light
- 6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sandmoulds for given Patterns. (**1 class**)
- 7. **Welding Shop:** Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint. (**1 class**)
- 8. **Advanced manufacturing processes:** Demonstration of injection moulding and 3 D printing processes. (**1 class**)
- 9. **Electronic Circuits:** Demonstration of preparation of simple electronic circuit (PCB) and testing its operation. (**1 class**)
- 10. **Basic IOT:** Demonstration of different components & pin configuration of Arduino board (**1 class**)
  - (a) Measure Temperature & Humidity
  - (b) Measure Distance

## PART-B

### GROUP ACTIVITY (2 classes)

- Students must prepare a Working model / Assembly using the knowledge gained from the above trades.

### TEXT BOOKS

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published, 2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

## **REFERENCE BOOKS**

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition.
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; At-ulPrakashan, 2021-22.

## **E-RESOURCES AND OTHER DIGITAL MATERIAL**

1. <https://dsceme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17-1.pdf>
2. <https://www.protosystech.com/rapid-prototyping.htm>
3. <https://www.arduino.cc/en/Tutorial/Foundations>
4. <https://www.tutorialspoint.com/arduino/>

## 23ES1155

### IT WORKSHOP

|                 |                      |                   |       |
|-----------------|----------------------|-------------------|-------|
| Course Category | Engineering Sciences | Credits           | 1     |
| Theory          | Laboratory           | L-T-P             | 0-0-2 |
| Prerequisites   | –                    | Continuous Eval   | 30    |
|                 |                      | Semester End Eval | 70    |
|                 |                      | Total Marks       | 100   |

### COURSE OUTCOMES

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

1. Perform Hardware troubleshooting
2. Understand Hardware components and inter dependencies
3. Safeguard computer systems from viruses/worms
4. Document/ Presentation preparation
5. Perform calculations using spreadsheets

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  |    |   | 2 |   | 3 |   |   |   |   |    |    |    |     |   |     |     |
| 1  |    |   | 2 |   | 3 |   |   |   |   |    |    |    |     |   |     |     |
| 2  |    |   | 2 |   | 3 |   |   |   |   |    |    |    |     |   |     |     |
| 3  |    |   | 2 |   | 1 |   |   |   |   |    |    |    |     |   |     |     |

### COURSE CONTENT

- **Task 1:** Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.
- **Task 2:** Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.
- **Task 3:** Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.
- **Task 4:** Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot

(VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

- **Task 5:** Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

### Internet and World Wide Web

- **Task1:** Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there is no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.
- **Task 2:** Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.
- **Task 3:** Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.
- **Task 4:** Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

### LaTeX and WORD

- **Task1-Word Orientation:** The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeX and word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.
- **Task 2-Using La TeX and Word to create a project certificate. Features to be covered:** Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word.
- **Task 3:** Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

- **Task 4:** Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

## EXCEL

- **Excel Orientation:** The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.
- **Task 1-Creating a Scheduler - Features to be covered:** Gridlines, Format Cells, Summation, auto fill, Formatting Text.
- **Task 2-Calculating GPA -. Features to be covered:** :- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function.
- **Task 3:** Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting.

## LOOKUP/VLOOKUP

- **Task 3:** Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting.

## POWER POINT

- **Task 1:** Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.
- **Task 2:** Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.
- **Task 3:** Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

## AI TOOLS – ChatGPT

- **Task 1-Prompt Engineering:** Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.
  - Ex: Prompt: “You are a knowledgeable AI. Please answer the following question: What is the capital of France?”

- **Task 2-Creative Writing:** Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas.
  - Ex: Prompt: “In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality.”
- **Task 3-Language Translation:** Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.
  - Ex:Prompt: “Translate the following English sentence to French;;Hello, how are you doing today?”

## REFERENCE BOOKS

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003.
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition.
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfinson and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition

## SEMESTER II



## 23BS2101

### DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

|                 |                  |                   |       |
|-----------------|------------------|-------------------|-------|
| Course Category | Basic Science    | Credits           | 3     |
| Course Type     | Theory           | L-T-P             | 3-0-0 |
| Prerequisites   | 23BS1101         | Continuous Eval   | 30    |
|                 | Linear Algebra & | Semester End Eval | 70    |
|                 | Calculus         | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Solve first order linear differential equations
2. Solve higher order linear differential equations with constant coefficients
3. Solve Partial differential equations
4. Evaluate the work done against field, circulation and flux using vector calculus

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 3  | 2 |   |   | 1 |   |   |   |   |    |    |    |     |   |     |     |
| 2  | 3  | 2 |   |   | 1 |   |   |   |   |    |    |    |     |   |     |     |
| 3  | 3  | 2 |   |   | 1 |   |   |   |   |    |    |    |     |   |     |     |
| 4  | 3  | 2 |   |   | 1 |   |   |   |   |    |    |    |     |   |     |     |

#### COURSE CONTENT

##### UNIT I-Differential equations of first order and first degree

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form, Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

##### UNIT II-Linear differential equations of higher order (Constant Coefficients)

Definitions, homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters, Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

##### UNIT III-Partial Differential Equations

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using

Lagrange's method, Homogeneous Linear Partial differential equations with constant coefficients.

#### **UNIT IV-Vector Calculus**

Scalar and vector point functions, vector operator Del, Del applies to scalar point functions- Gradient, Directional derivative, del applied to vector point functions- Divergence and Curl, vector identities.

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and related problems.

#### **TEXT BOOKS**

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition

#### **REFERENCE BOOKS**

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley Sons, 2018, 10th Edition.
2. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint)
4. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition
5. Advanced Engineering Mathematics, Michael Greenberg, Pearson publishers, 9th Edition
6. Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications, 2014, 3rd Edition (Reprint 2021)

#### **E-RESOURCES AND OTHER DIGITAL MATERIALS:**

1. Prof. Srinivas Rao Manam, IIT Madras, Differential equations for engineers [English], Available: [https://onlinecourses.nptel.ac.in/noc22\\_ma72/preview](https://onlinecourses.nptel.ac.in/noc22_ma72/preview)
2. Prof. Jitendra Kumar, IIT Kharagpur, Engineering Mathematics – I [English], Available: [https://onlinecourses.nptel.ac.in/noc20\\_ma37/preview](https://onlinecourses.nptel.ac.in/noc20_ma37/preview)
3. Prof. Jitendra Kumar, IIT Kharagpur, Engineering Mathematics – II [English], Available: [https://onlinecourses.nptel.ac.in/noc22\\_ma08/preview](https://onlinecourses.nptel.ac.in/noc22_ma08/preview)
4. Prof. Jitendra Kumar & Prof. Somesh Kumar, IIT Kharagpur, Advanced Calculus For Engineers [English], Available: [https://onlinecourses.nptel.ac.in/noc22\\_ma75/preview](https://onlinecourses.nptel.ac.in/noc22_ma75/preview)
5. Prof. Denis Auroux, Massachusetts Institute of Technology: MIT Open Courseware, Multivariable Calculus, Available: <https://ocw.mit.edu>

## 23BS2102B CHEMISTRY

|                 |                           |                   |       |
|-----------------|---------------------------|-------------------|-------|
| Course Category | Institutional Core        | Credits           | 3     |
| Course Type     | Theory                    | L-T-P             | 3-0-0 |
| Prerequisites   | 10 + 2 level<br>Chemistry | Continuous Eval   | 30    |
|                 |                           | Semester End Eval | 70    |
|                 |                           | Total Marks       | 100   |

### COURSE OUTCOMES

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

1. Apply the principles of quantum mechanics for determining structure and bonding of molecules
2. Apply the principles electrochemistry for its applications in chemical analysis, electrodes, electrochemical sensors and energy sources
3. Explain the mechanistic aspects of polymerisation and conduction, types, preparation, properties and applications of polymers
4. Compare different spectroscopic and chromatographic techniques for their application in qualitative and quantitative analysis
5. Choose engineering materials including nanomaterials based on their properties for their applications in various industrial fields

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 3  | 1 |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 2  | 2  |   | 3 |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 3  | 2  |   |   |   | 3 |   |   |   |   |    |    |    |     |   |     |     |
| 4  | 2  | 3 |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 5  | 2  |   |   |   | 3 |   | 1 |   |   |    |    |    |     |   |     |     |

### COURSE CONTENT

#### UNIT I

##### *Structure and Bonding Models:*

Fundamentals of Quantum mechanics, Schrodinger wave equation, significance of  $\Psi$  and  $\Psi^2$ , particle in one dimensional box, Molecular orbital theory, bonding in homo and heteronuclear diatomic molecules, energy level diagrams of O<sub>2</sub>, N<sub>2</sub>, NO and CO, calculation of bond order, - molecular orbitals of butadiene and benzene.

Engineering Materials: Semiconductors - Introduction, basic concept, applications, Superconductors - Introduction, basic concept, applications, Supercapacitors - Introduction, basic concept, classification, applications.

**UNIT II*****Electrochemistry:***

Electrochemical cell, Nernst equation, potential and emf calculations and numerical problems, potentiometry – potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, cell constant and specific conductance, conductometric titrations (acid-base titrations), Electrochemical sensors – potentiometric sensors and amperometric sensors-principle with examples.

***Electrochemical Energy Systems:***

Types of electrochemical energy systems - Primary cells – Zinc-air battery, Secondary cells – lithium-ion batteries – working of the batteries including cell reactions, Fuel cells – hydrogen-oxygen fuel cell- working of the cells, Polymer Electrolyte Membrane fuel cells (PEMFC).

**UNIT III*****Polymer Chemistry:***

Introduction to polymers, functionality of monomers, addition and condensation polymerization, mechanism of chain growth and step growth polymerization, coordination polymerization with specific examples. Plastics – Thermo and thermosetting plastics, preparation, properties and applications of PVC, Teflon, Bakelite, Nylon-6,6. Elastomers – Buna-S, Buna-N – Preparation, properties and applications. Conducting Polymers – Principle and examples, mechanism of conduction in undoped, doped polyacetylene and applications, Biodegradable polymers – polyglycolic acid (PGA), Polylactic acid (PLA).

**UNIT IV*****Instrumental Methods of Analysis:***

Electromagnetic spectrum, Interaction of radiation with matter, UV Visible Spectroscopy-principle, electronic transitions, Lambert-Beer's law, Instrumentation, applications, IR spectroscopy-principle, types of vibrations, selection rule, Instrumentation, Chromatography- basic principle and classification.

***Nano materials:***

Introduction, classification of nanomaterials. Properties and applications of fullerenes, carbon nanotubes, graphene and nanoparticles.

**TEXT BOOKS**

1. Engineering Chemistry, Jain and Jain, 17th Edition, Dhanpat Rai, 2018.
2. Engineering Chemistry, Prasantha Rath S. Aruna Kumari, Cengage Publishers, 2023.

**REFERENCE BOOKS**

1. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.
2. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
3. J.D. Lee, Concise Inorganic Chemistry, 5th Edition, Wiley Publications, Feb 2008

4. Textbook of polymer Science, Fred W. Billmeyer Jr, 3rd Edition.

**E-RESOURCES AND OTHER DIGITAL MATERIALS:**

1. [https://onlinecourses.nptel.ac.in/noc24\\_ph02/preview](https://onlinecourses.nptel.ac.in/noc24_ph02/preview)
2. [https://onlinecourses.nptel.ac.in/noc24\\_cy10/preview](https://onlinecourses.nptel.ac.in/noc24_cy10/preview)
3. [https://www.youtube.com/watch?v=LMSTMBX\\_2F4](https://www.youtube.com/watch?v=LMSTMBX_2F4)
4. <https://www.youtube.com/watch?v=7jOSbtR8mTs&list=PLzPro5owUhRSV-ezegDDfuNpuJ2uU6jZ0>
5. [https://onlinecourses.swayam2.ac.in/cec24\\_cy02/preview](https://onlinecourses.swayam2.ac.in/cec24_cy02/preview)

## 23ES2103B

### BASIC ELECTRICAL & ELECTRONICS ENGINEERING

|                 |                |                   |       |
|-----------------|----------------|-------------------|-------|
| Course Category | Program Core   | Credits           | 3     |
| Course Type     | Theory         | L-T-P             | 3-0-0 |
| Prerequisites   | 10 + 2 physics | Continuous Eval   | 30    |
|                 |                | Semester End Eval | 70    |
|                 |                | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Apply different techniques to solve DC circuits
2. Understand the magnetic circuit concepts
3. Analyze the steady-state response, series, parallel AC circuits, mesh & nodal analysis, and resonance
4. Apply network theorems for AC & DC circuits
5. Demonstrate the working principles of basic Electronic devices, circuits and instrumentation System
6. Implementation of simple Combinational and Sequential circuits using Logic gates

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 3  | 3 |   |   | 2 |   |   |   |   |    |    |    |     |   |     |     |
| 2  | 3  | 3 |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 3  | 2  | 3 |   |   | 2 |   |   |   |   |    |    |    |     |   |     |     |
| 4  | 2  | 3 |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 5  | 2  | 1 | 3 | 2 |   |   |   |   |   |    |    |    |     |   |     |     |
| 6  | 2  | 1 | 3 | 2 |   |   |   |   |   |    |    |    |     |   |     |     |

#### COURSE CONTENT

##### UNIT I-DC & AC Circuits

**DC Circuits:** Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

**AC Circuits:** A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R,

L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

**Equipment Safety Measures:** Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing phenomenon, Safety Precautions to avoid shock.

## UNIT II-Machines and Measuring Instruments

**Machines:** Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

**Measuring Instruments:** Construction and working principle of Voltage, Current, temperature sensors, basic block diagram of multimeter.

**Electricity bill:** Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of “unit” used for consumption of electrical energy, calculation of electricity bill for domestic consumers.

## UNIT III-SEMICONDUCTOR DEVICES

**Introduction:** Evolution of electronics, Vacuum tubes to nano electronics, Characteristics of PN Junction Diode, Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor, CB, CE, CC Configurations and Characteristics, Elementary Treatment of Small Signal CE Amplifier.

**Rectifiers and power supplies:** Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator.

**Amplifiers:** Block diagram of Public Address system, Circuit diagram.

**Electronic Instrumentation:** Block diagram of an electronic instrumentation system.

## UNIT IV-DIGITAL ELECTRONICS

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adders. Introduction to Flip flops, Registers and counters (Elementary Treatment only).

## TEXT BOOKS (for UNITS I & II)

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition.
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020.
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017.
4. Basic Electrical and Electronics Engineering, S. K. Bhattacharya, Person Publications, 2018, Second Edition.

**REFERENCE BOOKS (for UNITS I & II)**

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition.
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020.
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017.
4. Basic Electrical and Electronics Engineering, S. K. Bhattacharya, Person Publications, 2018, Second Edition.

**E-RESOURCES AND OTHER DIGITAL MATERIALS  
(for UNITS I & II)**

1. <https://nptel.ac.in/courses/108105053>
2. <https://nptel.ac.in/courses/10810807>

**TEXT BOOKS (for UNITS III & IV)**

1. R. L. Boylestad and Louis Nashlesky, Electronic Devices and Circuit Theory, Pearson Education, 2021.
2. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009.
3. Resnick, Halliday and Krane, "Physics", 5th edition, Wiley India Pvt. Ltd, New Delhi, 2016.

**REFERENCE BOOKS (for UNITS III & IV)**

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009

**E-RESOURCES AND OTHER DIGITAL MATERIALS  
(for UNITS III & IV)**

1. <https://embeddedengineers.files.wordpress.com/2015/09/electronic-devices-and-circuits-by-salivahanan.pdf>
2. <http://www.nptelvideos.in/2012/12/basic-electronics-drchitralekha-mahanta.html>
3. [https://en.wikipedia.org/wiki/Digital\\_electronics](https://en.wikipedia.org/wiki/Digital_electronics)



## 23PC2104A

### DATA STRUCTURES

|                 |                   |                   |       |
|-----------------|-------------------|-------------------|-------|
| Course Category | Professional Core | Credits           | 3     |
| Course Type     | Theory            | L-T-P             | 3-0-0 |
| Prerequisites   | 23ES1104          | Continuous Eval   | 30    |
|                 | Introduction to   | Semester End Eval | 70    |
|                 | Programming       | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Demonstrate the role of data structures in organizing and accessing data efficiently
2. Understand various techniques for searching, sorting and hashing algorithms used to solve complex problems
3. Demonstrate the operations on linear data structures like stack, queue and linked list
4. Analyze various operations on nonlinear data structures – binary tree, and binary search tree

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 2  |   |   | 2 |   |   |   |   |   |    |    |    |     |   |     |     |
| 2  | 3  | 2 | 1 | 2 |   |   |   |   |   |    |    |    |     |   |     |     |
| 3  | 2  | 2 | 1 | 2 |   |   |   |   |   |    |    |    |     |   |     |     |
| 4  | 2  | 2 | 1 | 2 |   |   |   |   |   |    |    |    |     |   |     |     |

#### COURSE CONTENT

##### UNIT I

**Basic Concepts:** Overview: System life cycle. Algorithm Specification, Data Abstraction, Performance Analysis, the Abstract Data Type.

**Searching:** Introduction to searching, Linear Search and Binary Search.

**Sorting:** Bubble Sort, Insertion Sort, Selection Sort.

##### UNIT II

**Linked Lists:** Linked lists, programming details, doubly linked lists, circularly linked lists, Examples: polynomial addition.

**Stacks:** Stack Model, Implementation of Stacks (arrays), Linked Stacks Applications: balancing the symbols, postfix expressions, infix to postfix conversion.

**UNIT III**

**Queues:** Queue Model, Array implementation of Queues, Applications of Queues: DFS, linked Queues, Types of Queues: Circular Queues, Dequeues.

**Trees:** Introduction, Binary Trees, Binary Tree traversals, Binary Search Tree – Definition, Search, Insertion, & Deletion.

**UNIT IV**

**Graphs:** Graph Abstract Datatype, Elementary Graph Operations- DFS, BFS.

**Hashing:** General idea, Hash Functions, separate chaining, open addressing, rehashing, extendable hashing.

**TEXT BOOKS**

1. BMark Allen Weiss , “Data Structures and algorithm analysis in C” , Pearson, 2nd Edition, 2016.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed , “Fundamentals of data structures in C” , University Press, 2020

**REFERENCE BOOKS**

1. Reema Thareja , “ Data Structures Using C ”, Second Edition, 2014, Oxford University Press.
2. Brad Miller and David Ranum , “Problem Solving with Algorithms and Data Structures” , 2013.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, “Introduction to Algorithms” , 3rd Edition, Mitpress.
4. YedidyahLangsam, Moshe J. Augenstein and Aaron M. Tenenbaum, “Data Structures using C and C++” , 2nd edition, Pearson Education, 1999.
5. Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with Applications” , 2nd edition, McGraw Hill, 2008.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. SudarshanIyengar: IIT Ropar, Data Structures and Algorithms, [NPTEL], (26, May, 2021) Available: <http://nptel.ac.in/>
2. Erik Demaine, Advanced Data Structures [MIT- OpenCourseWare], (26, May, 2021) Available: <http://ocw.mit.edu/>
3. Prof. Naveen Garg, IIT Delhi, Introduction to Data Structures and Algorithms, <https://nptel.ac.in/courses/106102064>

## 23ES2105

### ENGINEERING GRAPHICS

|                 |                    |                   |       |
|-----------------|--------------------|-------------------|-------|
| Course Category | Institutional Core | Credits           | 3     |
| Course Type     | Theory & Practice  | L-T-P             | 1-0-4 |
| Prerequisites   | NIL                | Continuous Eval   | 30    |
|                 |                    | Semester End Eval | 70    |
|                 |                    | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Understand the principles of engineering drawing, including engineering curves and scales
2. Draw and interpret orthographic projections of points, lines and planes in front, top and side views
3. Understand and draw projection of solids in various positions in first quadrant and Explain principles behind development of surfaces
4. Explain principles behind the Sections of solids, Prepare isometric views and conversion of simple solids

***Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)***

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 3  |   | 3 |   |   |   | 3 |   |   |    |    |    |     |   |     |     |
| 2  | 3  |   | 3 |   |   |   | 3 |   |   |    |    |    |     |   |     |     |
| 3  | 2  |   | 2 |   |   |   | 2 |   |   |    |    |    |     |   |     |     |
| 4  | 1  |   | 1 |   |   |   | 1 |   |   |    |    |    |     |   |     |     |

#### COURSE CONTENT

##### UNIT I

**Introduction:** Lines, Lettering and Dimensioning, Geometrical Constructions of regular polygons by general methods.

**Curves:** Construction of ellipse, parabola and hyperbola by general method and Involutives. Draw normal and tangent to Curves.

**Scales:** Plain scales and diagonal scales.

##### UNIT II

**Orthographic Projections:** Reference plane, importance of reference lines or Plane, Projections of a point situated in first quadrant only.

**Projections of Straight Lines:** Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference

plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes.

**Projections of Planes:** Regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

### UNIT III

**Projections of Solids:** Projections of solids(Prisms and Pyramids only) in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Projection of Solids with axis inclined to one reference plane and parallel to another plane.

**Development of Surfaces:** Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

**Computer graphics:** Creating 2D & 3D drawings of objects including PCB and Transformations using Auto CAD (Not for end examination).

### UNIT IV

**Sections of Solids:** Section planes perpendicular to VP and inclined to HP only, Sectional views (Front View and Top View only) and Sections of solids in simple position only.

**Isometric Views:** Draw an Isometric views of Simple solids.

**Conversion of Views:** Conversion of isometric views to orthographic views of Simple solids.

### TEXT BOOKS

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

### REFERENCE BOOKS

1. Engineering Drawing, Basant Agrawal and C M Agrawal, Tata McGraw Hill, 2009.
2. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
3. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc, 2009.
4. Engineering Drawing with an Introduction to Auto CAD, Dhananjay Jolhe , Tata McGraw Hill, 2017.

## 23BS1151 CHEMISTRY LAB

|                 |                                                         |                   |       |
|-----------------|---------------------------------------------------------|-------------------|-------|
| Course Category | Institutional Core                                      | Credits           | 1     |
| Laboratory      | Lab                                                     | L-T-P             | 0-0-2 |
| Prerequisites   | Knowledge of chemistry practicals at Intermediate level | Continuous Eval   | 30    |
|                 |                                                         | Semester End Eval | 70    |
|                 |                                                         | Total Marks       | 100   |

### COURSE OUTCOMES

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

1. Analyze acids from batteries and metal ions in solutions based on volumetric method
2. Apply standard procedures for preparation of nanomaterials, polymers and blueprinting
3. Analyze different solutions by applying various instrumental methods like conductometry, potentiometry, colorimetry, and chromatography

***Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)***

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 2  | 3 |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 2  | 3  |   |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 3  | 2  | 3 |   |   | 2 |   |   |   |   |    |    |    |     |   |     |     |

### COURSE CONTENT

#### List of Experiments

1. Determination of strength of acid in Lead-acid battery
2. Determination of ferrous iron by dichrometry
3. Determination of ferrous iron by permanganometry
4. Conductometric titration of a strong acid vs. strong base
5. Verification of Lambert-Beer's law
6. Potentiometric titration of a redox reaction
7. Chemistry of blueprinting
8. Conductometric titration of a weak acid vs. strong base
9. Determination of cell constant and conductance of solutions
10. Preparation of nanomaterials – Precipitation method
11. Preparation of urea-formaldehyde resin
12. Separation of ions by paper chromatography

**REFERENCE BOOKS**

1. “Vogel’s quantitative chemical analysis”, 6th Edition, by J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar, Pearson Publications.

## 23PC2152A

### DATA STRUCTURES LAB

|                 |                      |                   |       |
|-----------------|----------------------|-------------------|-------|
| Course Category | Professional core    | Credits           | 1.5   |
| Theory          | Lab                  | L-T-P             | 0-0-3 |
| Prerequisites   | 23ES1152-            | Continuous Eval   | 30    |
|                 | Computer Programming | Semester End Eval | 70    |
|                 | Lab                  | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Analyze the role of linear data structures in organizing and accessing data efficiently in algorithms
2. Design, implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation
3. Develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems
4. Apply queue-based algorithms for efficient task scheduling and breadth-first traversal in graphs and distinguish between dequeues and priority queues and apply them appropriately to solve data management challenges

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 2  | 2 | 1 |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 2  | 2  | 2 | 1 |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 3  | 2  | 1 | 1 |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 4  | 2  | 2 | 2 |   |   |   |   |   |   |    |    |    |     |   |     |     |

#### COURSE CONTENT

##### Week 1: Programs on Searching operation

**Objective:** Able to perform array manipulations like reversing the elements in an array and applying searching techniques like linear search and binary search.

- Write a program to reverse an array.
- Write C Programs to implement the Searching Techniques – Linear & Binary Search

##### Week 2: Sorting Techniques Implementation

**Objective:** Able to apply various sorting techniques like bubble sort, selection sort and insertion sort on an array of elements.

- Write a C Program to implement sorting using Bubble sort.

- ii. Write a C Program to implement sorting using Selection sort
- iii. Write a C Program to implement sorting using Insertion sort

**Week 3: Linked List Implementation**

**Objective:** Able to implement basic linked list operations like inserting a node, deleting a node, displaying data in the nodes of a linked list.

- i. Implement a singly linked list and perform insertion, deletion and traversal operations

**Week 4: Linked List Applications**

**Objective:** Able to implement Linked list applications like polynomial addition, removal of duplicates.

- i. Create a program to detect and remove duplicates from a linked list
- ii. Implement a linked list to represent polynomials and perform addition

**Week 5: Double Linked List and Circular Linked list Implementation**

**Objective:** Able to implement various operations on doubly linked list and circular linked list.

- i. Implement a doubly linked list and perform various operations to insert, delete, and traverse to understand its properties and applications
- ii. Implement a circular linked list and perform insertion, deletion, and traversal

**Week 6: Stack Operations**

**Objective:** Able to implement various stack operations using arrays and linked lists.

- i. Implement a stack using arrays and implement push, pop and traversal
- ii. Implement a stack using linked lists and implement push, pop and traversal

**Week 7: Queue Operations**

**Objective:** Able to implement various queue operations using arrays and linked lists.

- i. Implement a queue using arrays to perform the insertion, deletion and traversal
- ii. Implement a queue using linked lists to perform the insertion, deletion and traversal

**Week 8: Stack and Queue Applications**

**Objective:** Able to implement stack and queue applications.

- i. Use a stack to evaluate an infix expression and convert it to postfix
- ii. Create a program to determine whether a given string is a palindrome or not
- iii. Implement a stack or queue to perform comparison and check for symmetry

**Week 9: Binary Search Tree Implementation**

**Objective:** Able to construct a BST, and perform operations on it.

- i. Implementing a BST using Linked List to create, insert and delete nodes
- ii. Implement BST Traversal techniques in-order, pre-order, and post-order

**Week 10: Programs on hashing**

**Objective:** Able to implement hash tables and various collision resolution techniques.

- i. Implement a hash table with collision resolution techniques
- ii. Write a program to implement a simple cache using hashing

**Week 11: Programs on Graph data structures**

**Objective:** Able to perform operations on graph.



- i. Describe the operations on graph ADT and implement algorithm for Depth first search
- ii. Describe the operations on graph ADT and implement algorithm for Breath first search

### **TEXT BOOKS**

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2nd Edition.
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson- Freed, Silicon Press, 2008.

### **REFERENCE BOOKS**

1. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders
2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft
3. Problem Solving with Algorithms and Data Structures” by Brad Miller and David Ranum
4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms by Robert Sedgewick

### **E-RESOURCES**

1. SudarshanIyengar: IIT Ropar, Data Structures and Algorithms, [NPTEL], (26, May, 2021) Available: <http://nptel.ac.in/>
2. Erik Demaine, Advanced Data Structures [MIT- OpenCourseWare], (26, May, 2021) Available: <http://ocw.mit.edu/>
3. Prof. Naveen Garg, IIT Delhi, Introduction to Data Structures and Algorithms, <https://nptel.ac.in/courses/106102064>
4. Data Structures and applications on, [Geeksforgeeks], (25, May, 2021) Available: <https://www.geeksforgeeks.org/data-structures/>

## 23BS2154B

### HEALTH AND WELLNESS, YOGA AND SPORTS

|                 |               |                   |       |
|-----------------|---------------|-------------------|-------|
| Course Category | Basic Science | Credits           | 0.5   |
| Theory          | Theory        | L-T-P             | 0-0-1 |
| Prerequisites   | –             | Continuous Eval   | 30    |
|                 |               | Semester End Eval | 70    |
|                 |               | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Understand the importance of yoga and sports for Physical fitness and sound health
2. Demonstrate an understanding of health-related fitness components
3. Compare and contrast various activities that help enhance their health
4. Assess current personal fitness levels
5. Develop Positive Personality

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  |    |   |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 2  |    |   |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 3  |    |   |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 4  |    |   |   |   |   |   |   |   |   |    |    |    |     |   |     |     |

#### COURSE CONTENT

##### Unit I

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity  
Relationship between diet and fitness, Globalization and its impact on health, Body  
Mass Index (BMI) of all age groups.

##### Activities

- i. Organizing health awareness programmes in community
- ii. Preparation of health profile
- iii. Preparation of chart for balance diet for all age groups

##### Unit II

Concept of yoga, need for and importance of yoga, origin and history of yoga in  
Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and

meditation, stress management and yoga, Mental health and yoga practice.

**Activities**

- i. Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

**Unit III**

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

**Activities**

- i. Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc. Practicing general and specific warm up, aerobics
- ii. Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running

**Guidelines****General Guidelines**

**Objective:** Able to apply various sorting techniques like bubble sort, selection sort and insertion sort on an array of elements.

1. Institutes must assign slots in the Timetable for the activities of Health/ Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

**Evaluation Guidelines**

1. Evaluated for a total of 100 marks.
2. A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totaling to 90 marks.
3. A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

**REFERENCE BOOKS**

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022.
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice.
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014.
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. – 3rd ed. Human Kinetics, Inc.2014.

## 23MC2106

### DESIGN THINKING

#### (MANDATORY NON-CREDIT COURSE)

|                 |                      |                   |       |
|-----------------|----------------------|-------------------|-------|
| Course Category | Mandatory Course     | Credits           | 0     |
| Theory          | Practice             | L-T-P             | 2-0-0 |
| Prerequisites   | 10+2 or Intermediate | Continuous Eval   | 30    |
|                 |                      | Semester End Eval | 70    |
|                 |                      | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Understand the concepts of Design Thinking
2. Investigate a problem to determine its root cause
3. Able to develop design thinking skills and experiment with different solutions
4. Able to develop prototypes and can test

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  |    | 3 | 3 |   |   | 2 |   |   | 3 | 3  |    |    |     |   |     |     |
| 1  |    | 3 | 3 |   |   | 2 |   |   | 3 | 3  |    |    |     |   |     |     |
| 3  |    | 3 | 3 | 3 | 3 | 2 |   |   | 3 | 3  |    | 3  |     |   |     |     |
| 4  | 3  | 3 | 3 | 3 | 3 |   |   | 2 | 3 | 3  | 2  | 3  |     |   |     |     |

#### COURSE CONTENT

##### Unit I

**Introduction to Design Thinking:** Introduction to Design Thinking: Design Thinking Overview, Defining Design Thinking, Features and principles of Design thinking, Applications of Design Thinking.

##### Unit II

**Modules of Design Thinking:** Inspiration, methods & tools used in Explore and Empathize phases of Design Thinking, Case study-activity.

##### Unit III

**Modules of Design Thinking:** Inspiration, methods & tools used in Explore and Empathize phases of Design Thinking, Case study-activity.

##### Unit IV

**Prototype and Test Techniques:** Types of Prototypes, Exercise: Revise Franken

Prototype to Refined Prototype, Forms of Testing in Design Thinking, Prepare and Test of the Prototype.

### **TEXT BOOKS**

1. Design Thinking: A guide to creative problem solving for everyone, Andrew Pressman, Routledge Taylor and Francis group, 2019, 1st edition.
2. “Design Thinking for Entrepreneurs and Small Businesses” by Beverly Rudkin Ingle, Apress.
3. “Design Thinking- The Guide Book” – Facilitated by the Royal Civil Service Commission, Bhutan.
4. Idris Mootee, “Design Thinking for Strategic Innovation”, John Wiley & Sons (2013).

### **REFERENCE BOOKS**

1. Karmic Design Thinking - A Buddhism-Inspired Method to Help Create Human-Centered Products & Services, Dr Bala Ramadurai.
2. Design Thinking: A Beginners Perspective EB is written by Balagurusamy and published by Mc Graw-Hill Education India.
3. Design Thinking: A framework for applying Design Thinking in Problem Solving, Anujuna Agarwal Edition : 1st,2024.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

1. <https://www.arvindguptatoys.com/>
2. <https://honeybee.org/>
3. <https://dschool.stanford.edu/resources/getting-started-with-design-thinking>
4. <https://designthinking.ideo.com/>

## **SEMESTER III**

## 23HS3101 ENGINEERING ECONOMICS AND & MANAGEMENT

|                 |                                |                   |       |
|-----------------|--------------------------------|-------------------|-------|
| Course Category | Humanities and Social Sciences | Credits           | 2     |
| Course Type     | Theory                         | L-T-P             | 2-0-0 |
| Prerequisites   | -                              | Continuous Eval   | 30    |
|                 |                                | Semester End Eval | 70    |
|                 |                                | Total Marks       | 100   |

### COURSE OUTCOMES

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

1. Understand various forms of organizations and principles of management
2. Understand the various aspects of business economics.
3. Perceive the knowledge on Human resources and Marketing functions
4. Evaluate various alternatives economically.

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                      |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                          |
| 1  | 3  |   |   |   |   |   |   |   |   |    |    | 3  |     | 3 | 2   | 1.2.1, 1.7.1, 2.8.1                      |
| 2  | 3  |   |   |   | 3 |   |   |   |   |    |    | 3  |     | 3 | 2   | 1.2.1, 1.7.1, 2.8.1, 3.6.2, 4.6.1, 5.4.1 |
| 3  | 3  |   |   |   |   |   |   |   |   |    |    | 3  |     | 3 | 2   | 1.2.1, 1.7.1, 2.5.2, 5.5.2               |
| 4  | 3  |   |   |   | 3 |   |   |   |   |    |    | 3  |     | 3 | 4   | 1.2.1, 1.7.1, 2.5.2, 5.5.2               |

### COURSE CONTENT

#### UNIT I

**Forms of Business Organization:** Salient Features of Sole Proprietorship, Partnership, Joint Stock Company, Co-operative Society and Public Sector.

**Management:** Introduction to Management, Functions of Management, Principles of Scientific Management, Modern Principles of Management.

#### UNIT II

**Introduction to Economics:** Introduction to Basic Economic Concepts, Utility Analysis: Marginal Utility and Total Utility, Law of Diminishing Marginal Utility, Law of Equi Marginal Utility.

**Demand Analysis:** Theory of Demand: Demand Function, Factors Influencing Demand, Demand Schedule and Demand Curve, Shift in Demand, Elasticity of Demand: Elastic and Inelastic Demand, Types of Elasticity.

**Supply Analysis:** Supply Schedule and Supply Curve, Factors Influencing Supply, Supply Function.

### UNIT III

**Human Resource Management:** Meaning and difference between Personnel Management and Human Resource Management, Functions of Human Resource Management.

**Marketing Management:** Concept of Selling And Marketing – Differences, Functions of Marketing, Product Life Cycle, Concept of Advertising, Sales Promotion, Types of Distribution Channels, Marketing Research, Break-Even Analysis.

### UNIT IV

**Financial Management:** Functions of Financial Management, Time value of money with cash flow diagrams, Concept of Simple and Compound Interest.

**Depreciation:** Causes of depreciation, Factors influencing depreciation, common methods of Depreciation: Straight Line Method, Declining Balance Method, Sum of Year's Digits Method –Problems.

**Economic Alternatives:** Methods of Evaluating Alternatives under Present worth method, Future worth method, Annual Equivalent method - Problems.

### TEXT BOOKS

1. M. Mahajan Industrial Engineering and Production Management Dhanpat Rai Publications 2nd Edition.
2. Martand Telsang” Industrial & Business Management” S.Chand publications

### REFERENCE BOOKS

1. R.Paneer selvam “Production and Operations Management” PHI
2. Philip Kotler & Gary Armstrong “Principles of Marketing” ,pearson prentice Hall, New Delhi,2012 Edition.
3. IM Pandey, “Financial Management” Vikas Publications 11th Edition
4. B.B Mahapatro, “Human Resource Management”,New Age International, 2011

### E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. <https://www.toppr.com/guides/fundamentals-of-economics-and-management/supply/supply-function/>
2. <https://keydifferences.com/difference-between-personnel-management- and-human-resource-management.html>
3. <http://productlifecyclestages.com/>
4. <https://speechfoodie.com/cash-flow-diagrams/>



**23HS3102****UNIVERSAL HUMAN VALUES: UNDERSTANDING HARMONY**

|                 |                |                   |       |
|-----------------|----------------|-------------------|-------|
| Course Category | Basic Sciences | Credits           | 3     |
| Course Type     | Theory         | L-T-P             | 2-1-0 |
| Prerequisites   | –              | Continuous Eval   | 30    |
|                 |                | Semester End Eval | 70    |
|                 |                | Total Marks       | 100   |

**COURSE OUTCOMES**

1. Understand and aware of themselves and their surroundings(family, society and nature).
2. Handle problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. Exhibit critical ability and become sensitive to their commitment towards their understanding of human values, human relationship and human society.
4. Apply what they have learnt to their own self in different day-to-day settings in real life.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  |    |   |   |   |   | 1 |   |   | 2 |    |    |    |     |   | 2   |     |
| 2  |    |   | 3 |   |   |   |   |   |   |    |    |    |     |   | 2   |     |
| 3  |    |   |   |   |   | 2 |   |   |   |    |    |    |     |   | 3   |     |
| 4  |    |   |   |   |   |   |   | 3 |   |    |    | 2  |     |   | 3   |     |

**COURSE CONTENT****UNIT I**

***Course introduction, need, basic guidelines, content and process for value education:***

***Part-1:*** Purpose and motivation for the course, recapitulation from UHV-I, Self exploration: what is it?, its content and process, ‘Natural acceptance’ and experiential validation- as the process for self-exploration. Continuous Happiness and Prosperity– A look at basic Human Aspirations.

***Part-2:*** Right understanding, Relationship and Physical Facility– the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly– A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and

living in harmony at various levels. (Practice sessions are to be included to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking).

## UNIT II

### ***Understanding Harmony in the Human Being– Harmony in Myself:***

**Part-1** Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’. Understanding the needs of Self (‘I’) and ‘Body’– happiness and physical facility, Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer).

**Part-2:** Understanding the characteristics and activities of ‘I’ and harmony in ‘I’. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health. (Practice sessions are to be included to discuss the role others have played in making material goods available to me. Identifying from one’s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease).

## UNIT III

### ***Understanding Harmony in the Family and Society– Harmony in Human-Human Relationship:***

**Part-1** Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

**Part-2:** Understanding the harmony in the society (society being an extension of family); Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society–Undivided Society, Universal Order–from family to world family. (Practice sessions are to be included to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education, etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students’ lives).

## UNIT IV

### ***Understanding Harmony in Nature & Existence– Whole existence as Coexistence:***

**Part-1** Understanding the harmony in the Nature, Inter-connectedness and mutual fulfillment among the four orders of Nature– recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

**part-2:** Natural acceptance of human values, Definitiveness of ethical human conduct, Basis for humanistic education, humanistic constitution and humanistic universal order, Competence in professional ethics: a) ability to utilize the professional competence for augmenting universal human order, b) ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c) ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) at the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) at the level of society: as mutually enriching institutions and organizations. (Part-1: Practice sessions are to be included to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology, etc. Part-2: Practice exercises and case studies are to be taken up in practice (tutorial) sessions eg. to discuss the conduct as an engineer or scientist, etc.)

### **TEXTBOOKS**

1. Human values and professional ethics, R. R. Gaur, R. Sangal and G. P. Bagaria, Excel Books Private Limited, New Delhi (2010).

### **REFERENCE BOOKS**

1. JeevanVidya: EkParichaya, A. Nagaraj, JeevanVidya Prakashan, Amarkantak (1999).
2. Human Values, A. N. Tripathi, New Age International Publishers, New Delhi (2004).
3. The Story of Stuff: The impact of overconsumption on the planet, our communities, and our health and how we can make it better, Annie Leonard, Free Press, New York (2010).
4. The story of my experiments with truth: Mahatma Gandhi Autobiography, Mohandas Karamchand Gandhi, B. N. Publishing (2008).
5. Small is beautiful: A study of economics as if people mattered, E. F. Schumacher, Vintage Books, London (1993).
6. Slow is beautiful: New Visions of Community, Cecile Andrews, New Society Publishers, Canada (2006).
7. Economy of Permanence, J. C. Kumarappa, Sarva-Seva-Sangh Prakashan, Varanasi (2017).
8. Bharat Mein Angreji Raj, Pandit Sunderlal, Prabhath Prakashan, Delhi (2018).
9. Rediscovering India, Dharampal, Society for Integrated Development of Himilayas (2003).
10. Hind Swaraj or Indian Home Rule, M. K. Gandhi, Navajivan Publishing House, Ahmedabad (1909).
11. India Wins Freedom: The Complete Version, Maulana Abul Kalam Azad, Orient Blackswan (1988).

12. The Life of Vivekananda and the Universal gospel, Romain Rolland, Advaita Ashrama, India (2010).
13. Mahatma Gandhi: The Man who become one with the Universal Being, Romain Rolland, Srishti Publishers & Distributors, New Delhi (2002).

### **E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. AICTE– SIP Youtube Channel: <https://www.youtube.com/channel/UCo8MpJBaaVwB4LWLAX6AhQ> , Last Accessed On: 28/05/2025.
2. AICTE– UHV Teaching Learning Material:  
<https://fdp-si.aicte-india.org/download.php1> , Last Accessed On: 27/07/2025.

## 23BS3103B

### DISCRETE MATHEMATICS

|                 |                          |                   |       |
|-----------------|--------------------------|-------------------|-------|
| Course Category | Institutional Core       | Credits           | 3     |
| Course Type     | Theory                   | L-T-P             | 3-0-0 |
| Prerequisites   | Set theory,<br>Relations | Continuous Eval   | 30    |
|                 |                          | Semester End Eval | 70    |
|                 |                          | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Analyze of propositional calculus and first order logic
2. Apply the basic and advanced counting techniques
3. Analyze of relations and digraphs and their applications.
4. Analyze of graphs and their applications

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                               |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                   |
| 1  | 3  | 3 |   | 1 |   |   |   |   |   |    |    | 1  |     | 1 | 4   | 1.2.1,1.7.1, 2.5.1, 4.6.3, 12.4.2 |
| 2  | 3  | 3 |   | 1 |   |   |   |   |   |    |    | 1  |     | 1 | 3   | 1.2.1,2.5.1, 2.5.3, 12.4.2        |
| 3  | 3  | 3 |   | 1 |   |   |   |   |   |    |    | 1  |     | 1 | 4   | 1.2.1,2.8.1, 4.4.1, 12.4.2        |
| 4  | 3  | 3 |   | 1 |   |   |   |   |   |    |    | 1  |     | 1 | 4   | 1.2.1,2.5.3, 4.4.1 12.4.2         |

#### COURSE CONTENT

##### UNIT I Propositional Calculus:

**Fundamentals of Logic:** Propositions, Connectives, Propositional functions, Truth tables, Tautology, Contradiction, Logical equivalences, Normal forms, Logical inferences, Methods of proof of an implication.

**First Order Predicate Logic:** Predicate, Quantifiers, and Rules of inference for Quantified propositions.

##### UNIT II: Counting Techniques

**Basics of Counting:** Sum and product rules, Indirect counting, One to one correspondence, Combinations and permutations, Enumerating combinations and permutations with and without repetitions.

**Advanced Counting Techniques:** Generating function of sequences, Recurrence relations, Solving recurrence relations – substitution- Generating functions-The method of characteristic roots, Solution of inhomogeneous recurrences relations.

### **UNIT III: Relations and Digraphs**

Relations and basic graphs, Special properties of binary relations, Equivalence relation, Partially ordered sets, Hasse diagrams, Lattices, Operations on relations, Paths and closures, Directed graphs and Adjacency matrices, Transitive closure, Warshall's algorithm.

### **UNIT IV: Graph Theory**

Introduction(graphs, sub graphs, circuits, trees) Sum of degrees theorem, Isomorphism and sub graphs, planar graphs, Euler's formula, Multi graphs and Euler's circuits, Hamiltonian graphs, Grin-berg's theorem, Graph coloring, Chromatic numbers.

### **TEXT BOOKS**

1. J. L. Mott, A. Kandel, and T. P. Baker: Discrete Mathematics for Computer Scientists Mathematicians, PHI, 2nd Edition.

### **REFERENCE BOOKS**

1. J. P. Trembly and R. Manohar: Discrete Mathematical structures with applications to computer science, TMH.
2. K. H. Rosen: Discrete Mathematics and its Applications, Mc Graw Hill Companies, 7th Edition.
3. D. S. Malik and M. K. Sen: Discrete Mathematical Structures: Theory and applications

### **E-RESOURCES AND OTHER DIGITAL MATERIALS:**

1. Prof. Arindama Singh Department of Maths IIT Madras, Last accessed on 15-02-2022, <https://nptel.ac.in/courses/111/106/111106052/>
2. Prof SoumenMaity, Department of Maths, IISER Pune, Last accessed on 15-02-2022, <https://nptel.ac.in/courses/111/106/111106102/>
3. Dr.L.SunilChandran, Department of Computer Science and Automation, IISC Bangalore, Last accessed on 15-02-2022, <https://nptel.ac.in/courses/106/108/106108051/>

## 23ES3304

# DATABASE MANAGEMENT SYSTEMS

|                 |                     |                   |       |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits           | 3     |
| Course Type     | Theory              | L-T-P             | 2-0-2 |
| Prerequisites   | –                   | Continuous Eval   | 30    |
|                 |                     | Semester End Eval | 70    |
|                 |                     | Total Marks       | 100   |

### COURSE OUTCOMES

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

1. Understand the concepts of database systems.
2. Analyse the Entity-Relationship models, inturn develop the Relational models that leads to database design.
3. Apply various normalization techniques to relational models in order to improve database design quality.
4. Understand database transactions processing, protocols for Concurrency control, Recovery, indexing and storage techniques techniques for database.
5. Implement database management techniques using relational SQL database to real world applications

***Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)***

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                           |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                               |
| 1  | 1  | 2 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3             |
| 2  |    | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 1 | 4   | 2.5.2, 2.5.3, 2.6.3, 2.7.2, 3.5.6,3.6.2       |
| 3  |    | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 2.5.2, 2.5.3, 2.6.3, 2.7.2,3.5.6,3.6.2        |
| 4  | 1  | 2 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.7.1, 2.5.2, 2.6.3, 2.7.2                    |
| 5  |    | 2 | 3 |   | 3 |   |   |   |   |    |    |    | 2   | 2 | 5   | 2.5.2, 2.5.3, 2.6.3, 2.6.4,2.8.4,5.4.2, 5.5.2 |

### COURSE CONTENT

#### UNIT I

***Introduction to Database Systems:*** Introduction, An example, Characteristics of Database Approach, Advantages of Using the DBMS Approach,A Brief History of

Database Applications.

**Database System—Concepts and Architecture:** Data Models, Schemas and Instances, Three-schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment.

SQL Schema Definition, SQL Data Definition and Data Types, Specifying constraints in SQL, Basic retrieval queries in SQL, Additional features of SQL, More complex SQL Queries, Insert, Delete and Update statements in SQL, Joined Tables in SQL and Outer Joins, Aggregate functions, The GROUP BY and HAVING Clauses, Specifying Constraints as Assertions and Triggers, Views (Virtual Tables) in SQL, Schema Change Statement in SQL.

## UNIT II

**Data Modeling Using the Entity-Relationship Model:** Using High-Level Conceptual Data Models for Database Design; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types. Refining the ER Design, ER Diagrams, Naming Conventions, Relational Database Design using ER to-Relational Mapping.

**Relational Data Model and Relational Database Constraints:** Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations.

Relational Algebra: Unary Relational Operations, SELECT and PROJECT, Relational Algebra Operations from Set Theory Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra.

## UNIT III

**Relational Database Design:** Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form; Properties of Relational Decomposition; Multi valued Dependencies, Fourth Normal Form and Fifth Normal Form.

**Transaction Processing:** Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions. Serializability, Recoverability, Implementation of Isolation, Testing for Serializability.

## UNIT IV

**Concurrency Control and Recovery:** lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification.

Recovery Concepts, NO-UNDO/REDO Recovery Techniques based on Deferred Update, Recovery Techniques Based on Immediate Update, The ARIES Recovery Algorithm.

**Introduction to Indexing Techniques:** B+ Trees, operations on B+ Trees, Hash Based Indexing



**TEXT BOOKS**

1. Raghu Rama Krishnan, Johannes Gehrke, “Database Management Systems”, 3rd Edition, McGraw Hill Education, 2014 [UNIT II,III,IV]
2. Abraham Silberschatz, Henry F.Korth, S.Sudarshan, “Database System Concepts”, 7th edition, McGraw-Hill Education, 2019 [UNIT I, V]

**REFERENCE BOOKS**

1. Introduction to Database Systems, 8th edition, C J Date, Pearson.
2. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, 7th edition, Pearson Education Ltd, 2016.
3. Database Principles Fundamentals of Design Implementation and Management, Carlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Prof P.Srinivasa Kumar IIT-Madras “Normalization process” [https://nptel.ac.in/courses/106/106/106106095/Lecture 7](https://nptel.ac.in/courses/106/106/106106095/Lecture%207), Last accessed on 10/02/2022
2. D.Janakiram IIT-Madras “Concurrency Control techniques” [https://nptel.ac.in/courses/106/106/106106093/ Lecture 20,21,22,23](https://nptel.ac.in/courses/106/106/106106093/Lecture%2020%2C21%2C22%2C23) Last accessed on 10/02/2022
3. Andy Pavlo, Carnegie Mellon University, Relational model concepts, <https://15445.courses.cs.cmu.edu/fall2017/slides/01-introduction.pdf> Last accessed on 10/02/2022
4. Prof. Partha Pratim Das Prof. Samiran Chattopadhyay Prof. Kausik Datta, NOC:Data Base Management System, IIT Kharagpur <https://nptel.ac.in/courses/106/105/106105175/> Last accessed on 10/06/2024
5. [https://infyspringboard.onwingspan.com/web/en/login?ref=Flex\\_auth\\_01275806667282022456\\_shared](https://infyspringboard.onwingspan.com/web/en/login?ref=Flex_auth_01275806667282022456_shared)

## 23AI&DS3304

# ADVANCED DATA STRUCTURES & ALGORITHMS ANALYSIS

|                 |                 |                   |       |
|-----------------|-----------------|-------------------|-------|
| Course Category | Program Core    | Credits           | 3     |
| Course Type     | Theory          | L-T-P             | 2-1-0 |
| Prerequisites   | 23PC2104A       | Continuous Eval   | 30    |
|                 | Data Structures | Semester End Eval | 70    |
|                 |                 | Total Marks       | 100   |

### COURSE OUTCOMES

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

1. Understand algorithms, including recursive and randomized approaches, asymptotic notations, and the structures, operations, and applications of AVL and B-trees in computing.
2. Apply heap operations, graph algorithms for search, traversal, and component identification, and divide and conquer techniques for sorting, matrix multiplication, and convex hull problems.
3. Apply greedy method and dynamic programming techniques to solve different problems.
4. Apply backtracking and branch and bound techniques to solve different problems and compare P, NP, NP-Hard, and NP-Complete problems.

***Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)***

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                             |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                 |
| 1  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 2   |   | 2   | 1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3               |
| 2  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 2   |   | 3   | 1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4 |
| 3  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 2   |   | 3   | 1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4 |
| 4  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 2   |   | 3   | 1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4 |

## COURSE CONTENT

### UNIT I

**Introduction:** Algorithms, algorithms as a technology, recursive and randomized algorithms, growth of functions (Asymptotic notations)

**AVL Trees** Creation, Insertion, Deletion operations and Applications

**B-Trees** Creation, Insertion, Deletion operations and Applications.

### UNIT II

**Heap Trees (Priority Queues)** Min and Max Heaps, Operations and Applications.

**Graphs:** Terminology, Representations, Basic Search and Traversals, Connected Components and Biconnected Components, applications

**Divide and Conquer:** The General Method, Quick Sort, Merge Sort, Strassen's matrix multiplication, Convex Hull

### UNIT III

**Greedy Method:** General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths.

**Dynamic Programming:** General Method, All pairs shortest paths, Single Source Shortest Paths– General Weights (Bellman Ford Algorithm), Optimal Binary Search Trees, 0/1 Knapsack, String Editing, Travelling Salesperson problem.

### UNIT IV

**Backtracking:** General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, 0/1 Knapsack Problem.

**Branch and Bound:** The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem.

**NP Hard and NP Complete Problems:** Basic Concepts, Cook's theorem.

**NP Hard Graph Problems:** Clique Decision Problem (CDP), Chromatic Number Decision Problem (CNDP), Traveling Salesperson Decision Problem (TSP).

**NP Hard Scheduling Problems:** Scheduling Identical Processors, Job Shop Scheduling.

## TEXT BOOKS

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta, Dinesh, 2nd Edition Universities Press [Unit I, II]
2. Computer Algorithms in C++, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, 2nd Edition University Press [Unit II, III, IV]

## REFERENCE BOOKS

1. Data Structures and program design in C, Robert Kruse, Pearson Education Asia
2. An introduction to Data Structures with applications, Trembley & Sorenson,

McGraw Hill

3. Algorithms + Data Structures & Programs:, N.Wirth, PHI

## **E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. N.Garg, IIT Delhi, Dec 31, 2009, Data Structures and Algorithms, NPTEL, Available: <http://nptel.ac.in/courses/106102064/25>.
2. A. G. Ranade, S. Viswanathan, and A. A. Diwan, IIT Bombay, Dec 31, 2009, Design and Analysis of Algorithms, NPTEL, Available: <https://nptel.ac.in/courses/106/101/106101060/>(last accessed on 12-12-2022)
3. E. Demaine, S. Devadas, and N. Lynch, MIT, Design and Analysis of Algorithms, MIT OpenCourseWare, Available: (last accessed on 12-12-2022) <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2015/>(last accessed on 12-12-2022)
4. Timroughgarden.org.Tim Roughgarden's Online Courses. Available:<http://timroughgarden.org/videos.html>.(last accessed on 12-12-2022)
5. [https://www.tutorialspoint.com/advanced\\_data\\_structures/index.asp](https://www.tutorialspoint.com/advanced_data_structures/index.asp)
6. <http://peterindia.net/Algorithms.html>
7. Abdul Bari, Introduction to Algorithms (youtube.com), Last Accessed on: 24-06-2024.

## 23AI&DS3305

# OBJECT ORIENTED PROGRAMMING THROUGH JAVA

|                 |              |                   |       |
|-----------------|--------------|-------------------|-------|
| Course Category | Program Core | Credits           | 3     |
| Course Type     | Theory       | L-T-P             | 2-1-0 |
| Prerequisites   | -            | Continuous Eval   | 30    |
|                 |              | Semester End Eval | 70    |
|                 |              | Total Marks       | 100   |

### COURSE OUTCOMES

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

1. Understand the basic concepts of object oriented programming.
2. Apply multiple inheritance through interfaces for a given application.
3. Apply exceptions, thread capabilities and handling files on a given application.
4. Apply functional programming and Collections framework for a given application.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                                                       |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------------------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                                           |
| 1  | 2  | 3 |   |   |   |   |   |   |   |    |    |    |     |   | 2   | 1.7.1,2.5.1,<br>2.5.2, 2.7.1                                              |
| 2  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.7.1,2.5.1,2.5.2,<br>2.6.3, 2.7.1, 3.5.1,<br>3.8.2                       |
| 3  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.7.1,2.5.1, 2.5.2,<br>2.6.3, 2.6.4, 3.5.1,<br>3.8.2                      |
| 4  |    | 2 | 3 |   | 2 |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.7.1,2.5.1,2.5.2,<br>2.6.3,2.6.4, 3.5.1,<br>3.6.2, 3.8.2,4.6.2,<br>5.4.2 |

### COURSE CONTENT

#### UNIT I

**Object Oriented Programming:** Basic concepts, Principles of OOP, Java introduction, history and evolution, Java features, Java's Magic: Byte Code, Program Structure in Java, A First simple Program.

**Data Types, Variables, and Operators:** Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final.

**Introduction to Operators:** Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (-) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

**Control Statements:** Introduction, if Expression, Nested if Expressions, if-else Expressions, Ternary Operator? Switch Statement, Iteration Statements, while Expression, do-while Loop, for Loop, Nested for Loop, for-Each for Loop, Break Statement, Continue Statement.

**Introducing Classes and Objects:** Class fundamentals, declaring objects, assigning object reference variables, introducing methods, constructors, this keyword, Garbage collection, overloading methods, using objects as parameters, returning objects, static and final keywords, nested and inner classes.

## UNIT II

**String Handling in Java:** Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.

**Inheritance:** Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

**Interfaces:** Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

**Packages and Java Library:** Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class.

## UNIT III

**Exception handling:** Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

**Java I/O and File:** Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java(Text Book 2).

**Multithread Programming:** Introduction, Need for Multiple Threads Multi-

threaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.

## UNIT IV

**Pragmatic Functional Programming using Lambdas:** Introduction to Functional programming, Functional Programming concepts and terminology, Functional Interfaces, Working with Lambda Expressions and Method References.

**Collections Framework:** Collections overview, Collection interfaces: Collection, List, and Set. Collection Classes: ArrayList, LinkedList, HashSet. Map Classes: HashMap, TreeMapJ.

**The Stream API:** Stream basics, Reduction operations, Using parallel streams, Mapping, Collecting, Iterators and Streams.

## TEXT BOOKS

1. Herbert Schildt, "Java The Complete Reference", Eleventh Edition, Oracle Press, 2019.
2. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.

## REFERENCE BOOKS

1. Herbert Schildt, Dale Skrien, "Java Fundamentals A Comprehension Introduction", Special Indian Edition, McGraw-Hill Education India Pvt. Ltd, 2017.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, Debasis Samanta, Monalisa Sarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.
4. Paul J. Dietel and Dr. Harvey M. Deitel, "Java How to Program", Eleventh Edition, Deitel & Associates, Inc.1, 2018.

## E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Debasis Samanta. (14th, July, 2024), Department of Computer Science & Engineering, I.I.T., Kharagpur, Swayam, NPTEL.  
[https://onlinecourses.nptel.ac.in/noc21\\_cs03/preview](https://onlinecourses.nptel.ac.in/noc21_cs03/preview).
2. Evan Jones, Adam Marcus, Eugene Wu "Introduction to Programming in Java", MIT OpenCourseWare, Massachusetts Institute of Technology, Sep 28, 2024  
<https://ocw.mit.edu/courses>
3. Prof. Owen Astrachan, "Object Oriented Programming in Java", Duke University, 21st Aug 2024. coursera.org  
<https://www.coursera.org/specializations/object-oriented-programming>
4. Dheeru Mundluru, "Java In-Depth: Become a Complete Java Engineer", Udemy, 14th Aug 2024.  
<https://www.udemy.com/course/java-in-depth-become-a-complete-java-engineer/>

5. Prof. Olufisayo Omojokun, "Introduction to Object-Oriented Programming with Java I: Foundations and Syntax Basics", Georgia Institute of Technology, edX, Jul 2024.  
<https://www.edx.org/course/introduction-to-java-programming-i-foundations-and-syntax-basics>
6. <https://nptel.ac.in/courses/106/105/106105191/>
7. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_012880464547618816347\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview)



## 23TP3107

### LOGIC & REASONING

|                 |                   |                   |       |
|-----------------|-------------------|-------------------|-------|
| Course Category | Soft Skills-1     | Credits           | 1     |
| Course Type     | Learning by Doing | L-T-P             | 0-0-2 |
| Prerequisites   |                   | Continuous Eval   | 100   |
|                 |                   | Semester End Eval | 0     |
|                 |                   | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Think reason logically in any critical situation.
2. Analyze given information to find correct solution.
3. To reduce the mistakes in day to day activities in practical life.
4. Develop time management skills by approaching different shortcut methods.
5. Use mathematical based reasoning to make decisions.
6. Apply logical thinking to solve problems and puzzles in qualifying exams for companies and in other competitive exams.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI   |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |       |
| 1  |    |   |   |   |   | 2 |   |   |   |    |    |    |     |   | 2   | 6.2.1 |
| 2  |    | 2 |   |   |   |   |   |   |   |    |    |    |     |   | 4   | 2.2.3 |
| 3  |    |   |   |   |   |   |   | 2 |   |    |    |    |     |   | 2   | 8.2.2 |
| 4  |    |   |   |   |   |   |   |   | 2 |    |    |    |     |   | 3   | 9.2.1 |
| 5  | 2  |   |   |   |   |   |   |   |   |    |    |    |     |   | 3   | 1.4.1 |
| 6  | 1  |   |   |   |   |   |   |   |   |    |    |    |     |   | 3   | 1.4.1 |

#### COURSE CONTENT

##### UNIT I:

1. Series Completion
2. Coding-Decoding
3. Blood Relation
4. Puzzles test

##### UNIT II:

1. Direction sense test
2. Logical Venn diagrams
3. Number test, ranking test
4. Mathematical operations

**UNIT III:**

1. Arithmetical Reasoning
2. Inserting missing character
3. Syllogism

**UNIT IV: Non – Verbal:**

1. Water images
2. Mirror images
3. Paper folding
4. Paper cutting
5. Embedded Figures
6. Dot situation
7. Cubes & Dice

**TEXT BOOKS**

1. R. S. Aggarwal, “ Verbal and non-verbal reasoning” , Revised Edition, S Chand publication, 2017 ISBN:81-219-0551-6,

**23AI&DS3651**  
**PYTHON PROGRAMMING LAB**  
**(SKILL ENHANCEMENT COURSE)**

|                 |                      |                   |       |
|-----------------|----------------------|-------------------|-------|
| Course Category | Program core         | Credits           | 1     |
| Course Type     | Skill Enhancement    | L-T-P             | 0-0-2 |
| Prerequisites   | 23ES1152             | Continuous Eval   | 30    |
|                 | Computer Programming | Semester End Eval | 70    |
|                 | Lab                  | Total Marks       | 100   |

### COURSE OUTCOMES

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

1. Understand the python syntax and semantics of control flow statements
2. Apply functions, modules and string handling in Python to solve problems
3. Analyze the methods to create and manipulate programs with Python data structures
4. Analyse the concepts of object oriented approach to solve problems

***Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)***

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 2  | 2 | 1 |   | 2 |   |   |   |   |    | 1  |    | 3   |   | 3   |     |
| 2  |    |   | 1 |   | 2 |   |   |   |   |    | 1  |    | 1   |   | 3   |     |
| 3  |    | 1 | 1 |   | 1 |   |   |   |   |    | 1  |    | 2   |   | 3   |     |
| 4  |    | 3 | 2 |   | 2 |   |   |   |   |    | 2  |    | 3   |   | 4   |     |

### COURSE CONTENT

#### UNTI-I:

**History:** History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupiter Notebook.

**Parts of Python Programming Language:** Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

**Control Flow Statements:** if statement, if-else statement, if...elif... else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

**Functions:** Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of

Variables, Default Parameters, Keyword Arguments, \*args and \*\*kwargs, Command Line Arguments.

**Strings:** Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

### Sample Experiments

1. Write a program to find the largest element among three Numbers.
2. Write a Program to display all prime numbers within an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples.
  - (a) Arithmetic Operators
  - (b) Relational Operators
  - (c) Assignment Operators
  - (d) Logical Operators
  - (e) Bit wise Operators
  - (f) Ternary Operator
  - (g) Membership Operators
  - (h) Identity Operators
5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.
7. Write a program to define a function with multiple return values.
8. Write a program to define a function using default arguments.
9. Write a program to find the length of the string without using any library functions.
10. Write a program to check if the substring is present in a given string or not.

### UNIT-II:

**Lists:** Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

**Dictionaries:** Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

**Tuples and Sets:** Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip() Function, Sets, Set Methods, Frozenset.

### Sample Experiments

1. Write a program to perform the given operations on a list:
  - (a) Addition
  - (b) Insertion
  - (c) slicing
2. Write a program to perform any 5 built-in functions by taking any list.

3. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
4. Write a program to count the number of vowels in a string (No control flow allowed).
5. Write a program to check if a given key exists in a dictionary or not.
6. Write a program to add a new key-value pair to an existing dictionary.
7. Write a program to sum all the items in a given dictionary.

**UNTI-III:**

**Files:** Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

**Object-Oriented Programming:** Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

**Sample Experiments**

1. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
2. Python program to print each line of a file in reverse order.
3. Python program to compute the number of characters, words and lines in a file.
4. Write a program to create, display, append, insert and reverse the order of the items in the array.
5. Write a program to add, transpose and multiply two matrices.
6. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter.
7. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

**UNTI-V:** Introduction to Data Science: Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

**Sample Experiments**

1. Python program to check whether a JSON string contains complex object or not.
2. Python Program to demonstrate NumPy arrays creation using array () function.
3. Python program to demonstrate use of ndim, shape, size, dtype.
4. Python program to demonstrate basic slicing, integer and Boolean indexing.
5. Python program to find min, max, sum, cumulative sum of array
6. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows:
  - (a) Apply head () function to the pandas data frame

- (b) Perform various data selection operations on Data Frame
- 7. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

### TEXT BOOKS

1. ReemaThareja, “Python ProgrammingUsing Problem Solving Approach”, Oxford University Press, 2019.
2. Mastering Python for Data Science by Samir Madhavan Released August 2015 Publisher(s):Packt Publishing ISBN: 9781784390150

### REFERENCE BOOKS

1. Gowri shankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

### Online Learning Resources/Virtual Labs:

1. Charles Severance: University of Michigan,Python for Everybody [COURSE-ERA]. (05-01-2021),  
Available: <https://www.coursera.org/>
2. Prof. SudarshanIyengar, IIT Ropar, Prof. Yayati Gupta, IIIT Dharwad, The Joy Of Computing Using Python [NPTEL], (05-01-2021),  
Available:<https://nptel.ac.in/courses/106/106/106106182/>
3. Prof KannanMoudgalya, Professor, IIT Bombay, Python 3.4.3, [SWAYAM], (05-01-2021),  
Available: [https://onlinecourses.swayam2.ac.in/aic20\\_sp33/preview](https://onlinecourses.swayam2.ac.in/aic20_sp33/preview)
4. Corey Schafer,Python OOP Tutorials - Working with Classes, (05-01-2021),  
Available: Python OOP Tutorials - Working with Classes - YouTube
5. <https://www.coursera.org/learn/python-for-applied-data-science-ai>
6. <https://www.coursera.org/learn/python?specialization=python#syllabus>

## 23AI&DS3352

### ADVANCED DATA STRUCTURES & ALGORITHMS LAB

|                 |                     |                   |       |
|-----------------|---------------------|-------------------|-------|
| Course Category | Program Core        | Credits           | 1     |
| Course Type     | Laboratory          | L-T-P             | 0-0-2 |
| Prerequisites   | 23PC2152A           | Continuous Eval   | 30    |
|                 | Data Structures Lab | Semester End Eval | 70    |
|                 |                     | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Implement efficient binary trees, M-way search trees, graph traversal and shortest path algorithms.
2. Use divide and conquer, and greedy methods for implementing solutions for problems.
3. Implement solutions for problems using dynamic programming and backtracking.
4. Apply Branch and Bound techniques to write programs for different problems.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                      |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                          |
| 1  | 2  | 2 |   |   |   |   |   |   |   |    | 2  | 2  | 1   | 3 | 3   | 1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3 |
| 2  | 2  | 3 |   |   |   |   |   |   |   |    | 2  | 2  | 1   | 3 | 3   | 1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3 |
| 3  | 2  | 3 |   |   |   |   |   |   |   |    | 2  | 2  | 1   | 3 | 3   | 1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3 |
| 4  | 2  | 3 |   |   |   |   |   |   |   |    | 2  | 2  | 1   | 3 | 3   | 1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3 |

#### COURSE CONTENT

- **Task 1:** Construct an AVL tree for a given set of elements which are stored in a file. And implement insert and delete operation on the constructed tree. Write contents of tree into a new file using in-order.
- **Task 2:** Construct B-Tree an order of 5 with a set of 100 random elements stored in array. Implement searching, insertion and deletion operations.

- **Task 3:** Construct Min and Max Heap using arrays, delete any element and display the content of the Heap.
- **Task 4:** Implement BFT and DFT for given graph, when graph is represented by
  1. Adjacency Matrix
  2. Adjacency Lists
- **Task 5:** Write a program for finding the bi-connected components in a given graph.
- **Task 6:** Implement Quick sort and Merge sort and observe the execution time for various input sizes (Average, Worst and Best cases).
- **Task 7:** Compare the performance of Single Source Shortest Paths using Greedy method when the graph is represented by adjacency matrix and adjacency lists.
- **Task 8:** Implement Job sequencing with deadlines using Greedy strategy.
- **Task 9:** Write a program to solve 0/1 Knapsack problem Using Dynamic Programming.
- **Task 10:** Implement N-Queens Problem Using Backtracking.
- **Task 11:** Use Backtracking strategy to solve 0/1 Knapsack problem.
- **Task 12:** Implement Travelling Sales Person problem using Branch and Bound approach.

## TEXT BOOKS

1. T.H.Cormen,C.E.Leiserson, R.L.Rivest and C.Stein, “Introduction to Algorithms”, 2/e, PHI Pvt. Ltd., Pearson Education, 2009.
2. Ellis Horowitz, SatrajSahni and Rajasekharan, “Fundamentals of Computer Algorithms”, Galgotia Publications Pvt. Ltd, 2008.

## REFERENCE BOOKS

1. Fundamentals of Data Structures in C++, Horowitz Ellis, Sahni Sartaj, Mehta, Dinesh, 2nd Edition, Universities Press
2. Computer Algorithms/C++ Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, 2nd Edition, University Press
3. Data Structures and program design in C, Robert Kruse, Pearson Education Asia
4. An introduction to Data Structures with applications, Trembley & Sorenson, McGraw Hill



**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. N.Garg, IIT Delhi, Dec 31, 2009, Data Structures and Algorithms, NPTEL, Available: <http://nptel.ac.in/courses/106102064/25>.
2. A. G. Ranade, S. Viswanathan, and A. A. Diwan, IIT Bombay, Dec 31, 2009, Design and Analysis of Algorithms, NPTEL, Available: <https://nptel.ac.in/courses/106/101/106101060/>(last accessed on 12-12-2022)
3. E. Demaine, S. Devadas, and N. Lynch, MIT, Design and Analysis of Algorithms, MIT OpenCourseWare, Available: <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2015/>
4. Timroughgarden.org.Tim Roughgarden's Online Courses. Available:<http://timroughgarden.org/videos.html>.(last accessed on 12-12-2022)
5. <http://cse01-iiith.vlabs.ac.in/>
6. <http://peterindia.net/Algorithms.html>

## 23AI&DS3353

# OBJECT ORIENTED PROGRAMMING THOROUGH JAVA LAB

|                 |                      |                   |       |
|-----------------|----------------------|-------------------|-------|
| Course Category | Program Core         | Credits           | 1.5   |
| Course Type     | Laboratory           | L-T-P             | 0-0-3 |
| Prerequisites   | 23ES1152             | Continuous Eval   | 30    |
|                 | Computer Programming | Semester End Eval | 70    |
|                 | Lab –                | Total Marks       | 100   |

### COURSE OUTCOMES

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

1. Design solutions to applications using object oriented approach using Java.
2. Implement java technology to solve runtime errors and test the correctness of programs using exception handling and assertions.
3. Develop java applications to make use of I/O Streams and multithreading to solve real world problems.
4. Solve real world problems using Collections framework.

***Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)***

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                                            |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                                |
| 1  | 2  |   |   |   | 1 |   |   |   |   |    | 3  |    | 2   | 1 | 3   | 1.7.1, 2.5.1, 2.5.2, 2.7.1, 4.1, 5.4.2, 11.4.1                 |
| 2  |    | 2 | 3 |   | 2 |   |   |   |   |    | 2  |    | 3   | 1 | 3   | 2.5.1, 2.5.2, 2.6.3, 2.7.1, 3.5.1, 3.8.2, 5.4.1, 5.4.2, 11.4.1 |
| 3  |    | 2 | 2 |   | 3 |   |   |   | 3 |    | 2  | 2  | 2   | 2 | 5   | 2.5.1, 2.5.2, 3.5.1, 3.8.2, 5.4.1, 5.4.2, 9.6.1, 11.4.1        |
| 4  |    | 2 | 2 |   | 3 |   |   |   | 3 |    | 2  | 2  | 2   | 2 | 3   | 2.5.1, 2.5.2, 3.5.1, 3.8.2, 5.4.1, 5.4.2, 9.6.1, 11.4.1        |

### COURSE CONTENT/TASK

**Task 1:** Apply fundamentals of Java Data types, Variables, Operators, and Control Statements.

**Task 2:** Apply the concepts of Classes and Objects.

**Task 3:** Apply the concepts of Arrays.

**Task 4:** Apply the concepts of String and String Tokenizer classes.

**Task 5:** Apply the concepts of Inheritance and types of Inheritance.

**Task 6:** Apply the concepts of Method Overloading and Method Overriding.

**Task 7:** Apply the concepts of Packages.

**Task 8:** Apply the concepts of Interfaces.

**Task 9:** Apply the concepts of Exception Handling.

**Task 10:** Develop a Java application to copy content from one file to another file using I/O Streams.

**Task 11:** Apply the concepts of Threads and Multithread.

**Task 12:** Design Employee Database for company or Organization (Employee Personal Details, Department, Salary (basic, DA, HRA.,) Details) and develop JDBC based java application for following tasks.

1. Insert Records into respective table
2. Select records of particular table of database
3. Delete Records from table.

Connect java FX GUI application to database and perform SQL commands via JDBC API.

### **Lab Projects:**

1. A group project with unique topics.

### **TEXT BOOKS**

1. Herbert Schildt, “Java The Complete Reference”, Eleventh Edition, Oracle Press, . 2019.

### **REFERENCE BOOKS**

1. Herbert Schildt, Dale Skrien, “Java Fundamentals A Comprehension Introduction”, Special Indian Edition, McGraw-Hill Education India Pvt. Ltd, 2017.
2. E Balaguruswamy, ”Programming with Java”, 4th Edition, Mc Graw Hill , 2020.
3. Paul J. Dietel and Dr.Harvey M. Deitel, “Java How to Program”, Eleventh Edition, Deitel & Associates, Inc.l , 2018.
4. Timothy Budd, “Understanding Object Oriented Programming with Java “, Updated edition,Pearson Education, 2013.
5. Kathy Sierra & Bert Bates, ”Head First Java”, 2nd Edition, Oreilly.

### **E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Prof. Debasis Samanta. (14th,July, 2024), Department of Computer Science & Engineering, I.I.T.,Kharagpur, Swayam, NPTEL. [https://onlinecourses.nptel.ac.in/noc21\\_cs03/preview](https://onlinecourses.nptel.ac.in/noc21_cs03/preview).
2. Evan Jones, Adam Marcus,Eugene Wu ”Introduction to Programming in Java”, MIT OpenCourseWare, Massachusetts Institute of Technology, Sep 28, 2024. <https://ocw.mit.edu/courses>

3. Prof. Owen Astrachan, "Object Oriented Programming in Java", Duke University, 21st Aug 2024. coursera.org <https://www.coursera.org/specializations/object-oriented-programming>
4. Dheeru Mundluru, "Java In-Depth: Become a Complete Java Engineer", Udemy, 14th Aug 2024. <https://www.udemy.com/course/java-in-depth-become-a-complete-java-engineer/>
5. Prof. Olufisayo Omojokun, "Introduction to Object-Oriented Programming with Java I: Foundations and Syntax Basics", Georgia Institute of Technology, edX, Jul 2024. <https://www.edx.org/course/introduction-to-java-programming-i-foundations-and-syntax-basics>

## **SEMESTER IV**

## 23BS4101A

### STATISTICAL METHODS FOR DATA SCIENCE

|                 |               |                   |       |
|-----------------|---------------|-------------------|-------|
| Course Category | Basic Science | Credits           | 3     |
| Course Type     | Theory        | L-T-P             | 3-0-0 |
| Prerequisites   | -             | Continuous Eval   | 30    |
|                 |               | Semester End Eval | 70    |
|                 |               | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Analyze probability distributions with random variables
2. Apply knowledge of Continuous Random Variables and Probability Densities
3. Apply random phenomena of sample to test the Hypothesis concerning means
4. Analyze random phenomena of sample to test the hypothesis concerning variances and regression

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                        |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                            |
| 1  | 3  | 3 |   |   | 2 |   |   |   |   |    |    |    | 1   |   | 4   | 1.2.1, 1.2.2, 2.6.3, 4.6.1 |
| 2  | 3  | 3 |   |   | 2 |   |   |   |   |    |    |    | 1   |   | 3   | 1.2.1, 1.2.2, 2.6.3, 4.6.1 |
| 3  | 3  | 3 |   |   | 2 |   |   |   |   |    |    |    | 1   |   | 3   | 1.2.2, 2.6.3, 4.6.1, 4.6.3 |
| 4  | 3  | 3 |   |   | 2 |   |   |   |   |    |    |    | 1   |   | 4   | 1.2.2, 2.6.3, 4.6.1, 4.6.3 |

#### COURSE CONTENT

##### UNIT I

**Probability Theory:** Sample Spaces and events -Counting – Probability-The Axioms of Probability- Conditional Probability -Bayes' Theorem.

**Probability Distributions:** Random Variables (discrete and continuous) -Expectation- Variance and Standard deviation of discrete random variable- Binomial distribution- Poisson distribution.

##### UNIT II

**Probability Densities:** Continuous random variables – The Normal Distribution

– The Normal approximation to the Binomial Distribution.

**Other Probability Densities:** The Uniform Distribution – The Log Normal Distribution – The Gamma Distribution-The Beta Distribution – The Weibull distribution.

### UNIT III

**Sampling Distributions:** Introduction- Populations and Samples.

**Inferences Concerning Mean:** Point Estimation- Interval Estimation.

**Test of Hypothesis:** Null Hypothesis and Tests of Hypothesis – Hypothesis concerning one mean – Relation between tests and Confidence intervals –Operating characteristic curves - Inferences concerning two means.

### UNIT IV

**Inferences Concerning Variances:** Estimation of variances- Hypothesis concerning one variance- Hypothesis concerning two variances.

**Regression Analysis:** The method of least squares - Multiple Regression- Correlation- Karl Pearson's coefficient of correlation.

### TEXT BOOKS

1. Johnson, R. A. (2011). Probability and statistics for engineers (8th ed.). Prentice Hall India Learning Private Limited.

### REFERENCE BOOKS

1. Walpole, R. E., Myers, R. H., Myers, S. L., Ye, K. (1993). Probability and statistics for engineers and scientists (Vol. 5). New York: Macmillan
2. Biswal, P. C.(2007). Probability and statistics. Prentice Hall India Learning Private Limited.
3. Iyengar, T. K. V., Gandhi, B. K., Ranganadham, S., Prasad, M. V. S. S. N.(2008). Probability and statistics. S. Chand Publishing.

### E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. Prof. Somesh Kumar, Department of Maths, IIT Kharagpur, <https://nptel.ac.in/courses/111105090>
2. Prof. Niladri Chatterjee, Department of Maths, IIT Delhi, <https://nptel.ac.in/courses/111102112>
3. Prof. Soumen Maity, Department of Maths, IISER Pune, <https://nptel.ac.in/courses/111105042>

## 23AI&DS4302

### ARTIFICIAL INTELLIGENCE

|                 |                                                  |                   |       |
|-----------------|--------------------------------------------------|-------------------|-------|
| Course Category | Programme Core                                   | Credits           | 3     |
| Course Type     | Theory                                           | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS3305                                      | Continuous Eval   | 30    |
|                 | Advanced Data Structures and Algorithms Analysis | Semester End Eval | 70    |
|                 |                                                  | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Understand the AI agents for problem solving
2. Understand AI solutions using Heuristic and Pruning approaches
3. Apply various knowledge representation techniques
4. Apply the logic concepts and learnings to Expert Systems

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                   |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                       |
| 1  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.2.1,1.6.1,1.7.1, 2.5.2, 2.6.4,3.5.1 |
| 2  | 1  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.6.1,1.7.1, 2.5.2, 2.6.4,2.8.1,3.5.1 |
| 3  | 1  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.6.1,1.7.1, 2.5.2, 2.6.4,3.5.1       |
| 4  | 1  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.6.1,1.7.1, 2.5.2, 2.6.4,2.7.1,3.5.1 |

#### COURSE CONTENT

##### UNIT I

**Introduction:** AI problems, foundation of AI and history of AI.

**Intelligent agents:** Agents and Environments, the concept of rationality, the nature of environments, structure of agents.

**Problem solving agents:** Well defined problems and Solutions, problem formulation, Example problems- 8-puzzle problem, Water jug problem.

##### UNIT II

**Searching:** Searching for solutions, uniformed search strategies – Breadth first search, depth first Search.



**Heuristic Search:** Informed search strategies, Hill climbing, Best First search, A\* Algorithm, Problem Reduction -AO\* Algorithms.

**Adversarial Search:** Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions.

### UNIT III

**Representation of Knowledge:** Weak Slot and filler structures, Semantic nets-frames and frame systems.

**Representing knowledge using rules:** Procedural versus declarative knowledge, Logic programming, Forward vs Backward reasoning.

**Knowledge Representation Issues:** Representation and mapping, Approaches in knowledge representation, Issues in knowledge representation. Reasoning under uncertainty.

### UNIT IV

**Logic concepts:** Predicate Logic, Propositional vs. Predicate Logic, unification , Resolution.

**Learning:** Learning from observation, Explanation based learning, Statistical Learning methods, Reinforcement Learning.

**Expert Systems:** Architecture of expert systems, Roles of expert systems, Knowledge Acquisition, Typical expert systems – MYCIN, DART, Expert systems shells.

### TEXT BOOKS

1. S. Russel and P. Norvig, “Artificial Intelligence – A Modern Approach”, Second Edition, Pearson Education.
2. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill

### REFERENCE BOOKS

1. David Poole, Alan Mackworth, Randy Goebel, “Computational Intelligence: a logical approach”, Oxford University Press.
2. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problemsolving”, Fourth Edition, Pearson Education.
3. J. Nilsson, “Artificial Intelligence: A new Synthesis”, Elsevier Publishers.
4. Artificial Intelligence, SarojKaushik, CENGAGE Learning.

### E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. Fundamentals of Artificial Intelligence, [https://swayam.gov. in/nd1\\_noc19\\_me71/preview](https://swayam.gov.in/nd1_noc19_me71/preview), Last Accessed on 12-11-2024
2. [https://swayam.gov.in/nd1\\_noc19\\_me71/preview](https://swayam.gov.in/nd1_noc19_me71/preview), Last Accessed on 12-11-2024

## 23AI&DS4303

### INTRODUCTION TO DATA SCIENCE

|                 |                 |                   |       |
|-----------------|-----------------|-------------------|-------|
| Course Category | Programme Core  | Credits           | 3     |
| Course Type     | Theory          | L-T-P             | 3-0-0 |
| Prerequisites   | 23PC2104A       | Continuous Eval   | 30    |
|                 | Data Structures | Semester End Eval | 70    |
|                 |                 | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Understand the significance of Data Science
2. Analyze large data and apply NoSql for handling Bigdata
3. Apply Data Analytics tools for various data science applications
4. Apply Visualization and Development tools for data

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                      |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                          |
| 1  | 3  |   |   |   |   |   |   |   |   |    |    |    | 2   |   | 2   | 1.2.1,1.6.1,1.7.1, 2.5.2, 2.6.4,3.5.1    |
| 2  | 3  | 3 | 1 |   |   |   |   |   |   |    |    |    | 2   |   | 4   | 1.7.1, 2.6.3, 2.6.4, 2.8.3, 4.6.1        |
| 3  | 3  | 2 | 1 |   |   |   |   |   |   |    |    |    | 2   |   | 3   | 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1 |
| 4  | 3  | 3 | 1 |   |   |   |   |   |   |    |    |    | 2   |   | 3   | 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1 |

#### COURSE CONTENT

##### UNIT I

Introduction to Data science, benefits and uses, facets of data, data science process in brief, big data ecosystem and data science

**Data Science process:** Overview, defining goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory analysis, model building, presenting findings and building applications on top of them.

Applications of machine learning in Data science, role of ML in DS, Python tools like sklearn, modelling process for feature engineering, model selection, validation and prediction, types of ML, semi-supervised learning.

**UNIT II**

**Handling large data:** problems and general techniques for handling large data, programming tips for dealing large data, case studies on DS projects for predicting malicious URLs, for building recommender systems.

**NoSQL movement for handling Bigdata:** Distributing data storage and processing with Hadoop framework, case study on risk assessment for loan sanctioning, ACID principle of relational databases, CAP theorem, base principle of NoSQL databases, types of NoSQL databases, case study on disease diagnosis and profiling.

**UNIT III**

**Tools and Applications of Data Science:** PIntroducing Neo4jfor dealing with graph databases, graph query language Cypher, Applications graph databases, Python libraries like nltk and SQLite for handling Text mining and analytics, case study on classifying Reddit posts.

**UNIT IV**

**Data Visualization and Prototype Application Development:** Data Visualization options, Crossfilter, the JavaScript MapReduce library, Creating an interactive dashboard with dc.js, Dashboard development tools.

Applying the Data Science process for real world problem solving scenarios as a detailed case study

**TEXT BOOKS**

1. Davy Cielen, Arno D.B.Meysman, and Mohamed Ali, “Introducing to Data Science using Python tools”, Manning Publications Co, Dreamtech press, 2016.
2. Prateek Gupta, “Data Science with Jupyter” BPB publishers, 2019 for basics

**REFERENCE BOOKS**

1. Joel Grus, “Data Science From Scratch”, OReilly, 2019.
2. Doing Data Science: Straight Talk From The Frontline, 1 st Edition, Cathy O’Neil and Rachel Schutt, O’Reilly, 2013.

**E-RESOURCES AND OTHER DIGITAL MATERIALS:**

1. Python Data Science Handbook <https://jakevdp.github.io/PythonDataScienceHandbook>, Last accessed on 12-11-2024
2. Free interactive course on machine learning fundamentals.<https://developers.google.com/machine-learning/crash-course> Lat accessed on 12-11-2024
3. Tutorials - Getting Started - Neo4j Graph Data Platform
4. Best Online Hadoop Courses and Programs - edX

## 23AI&DS4304

### DIGITAL LOGIC AND COMPUTER DESIGN

|                 |                |                   |       |
|-----------------|----------------|-------------------|-------|
| Course Category | Programme Core | Credits           | 3     |
| Course Type     | Theory         | L-T-P             | 3-0-0 |
| Prerequisites   | –              | Continuous Eval   | 30    |
|                 |                | Semester End Eval | 70    |
|                 |                | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Understand digital logic principles and basic structure of a computer
2. Apply concepts of combinational and sequential logic to design digital circuits
3. Apply algorithms to perform arithmetic operations on fixed point and floating point data
4. Understand Processor, Memory and I/O organization of basic computer

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                              |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                  |
| 1  | 2  |   |   |   |   |   |   |   |   |    |    |    | 1   |   | 2   | 1.2.1, 1.7.1                     |
| 2  | 1  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   |   | 3   | 1.7.1,2.7.1, 2.7.2, 3.7.1 ,3.8.1 |
| 3  | 1  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   |   | 3   | 1.6.1,1.7.1, 2.7.1, 2.8.1        |
| 4  | 1  | 2 |   |   |   |   |   |   |   |    |    |    | 1   |   | 2   | 1.7.1, 2.7.1,2.8.1               |

#### COURSE CONTENT

##### UNIT I

**Data Representation:** Binary Numbers, Fixed Point Representation. Floating Point Representation. Number base conversions, Octal and Hexadecimal Numbers, components, Signed binary numbers, Binary codes.

**Digital Logic Circuits-I:** Basic Logic Functions, Logic gates, universal logic gates, Minimization of Logic expressions. K-Map Simplification, Combinational Circuits, Decoders, Multiplexers.

##### UNIT II

**Digital Logic Circuits-II:** Sequential Circuits, Flip-Flops, Binary counters, Registers, Shift Registers, Ripple counters.

**Basic Structure of Computers:** Computer Types, Functional units, Basic operational concepts, Bus structures, Software, Performance, multiprocessors and multi computers, Computer Generations, Von- Neumann Architecture.

### UNIT III

**Computer Arithmetic:** Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-operand Multiplication, Fast Multiplication, Integer Division, Floating-Point Numbers and Operations.

**Processor Organization:** Fundamental Concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired Control and Multi programmed Control.

### UNIT IV

**The Memory Organization:** Basic Concepts, Semiconductor RAM Memories, Read-Only Memories, Speed, Size and Cost, Cache Memories, Performance Consideration, Virtual Memories, Memory Management Requirements, Secondary Storage.

**Input/Output Organization:** Accessing I/O Devices, Interrupts, Processor Examples, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces.

### TEXT BOOKS

1. Morris Mano, Digital Logic and Computer Design, Pearson Education, 16th Impression, 2016.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, McGraw Hill, 5th Edition, 2014.
3. William Stallings, Computer Organization and Architecture, Pearson Education, 11th Edition, 2012.

### REFERENCE BOOKS

1. M.Moris Mano, Computer Systems Architecture, Pearson Education, 3rd Edition, 2009.
2. Design, David A. Paterson, John L. Hennessy, Elsevier, Computer Organization and 2nd Edition, 2010.
3. Roth, Fundamentals of Logic Design, Thomson, 5th Edition, 2014.

### E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. IIT Guwahati Prof. Jatindra Kumar Deka<https://nptel.ac.in/courses/106103068>, Computer Organization and Architecture, Last Accessed On: 31-05-2024

## 23TP4106

### ENGLISH FOR PROFESSIONALS

|                 |                   |                   |       |
|-----------------|-------------------|-------------------|-------|
| Course Category | Soft Skills - 2   | Credits           | 1     |
| Course Type     | Learning by Doing | L-T-P             | 0-0-2 |
| Prerequisites   | –                 | Continuous Eval   | 100   |
|                 |                   | Semester End Eval | 0     |
|                 |                   | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Present themselves effectively in the professional world
2. Introduce themselves as well as others appropriately
3. Use vocabulary to form sentences and narrate stories by using creative thinking skills
4. Involve in practical activity oriented sessions
5. Learn about various expressions to be used in different situations

***Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)***

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                   |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                       |
| 1  |    |   |   |   |   |   |   |   |   | 3  | 3  |    |     |   | 2   | 1.2.1, 1.7.1,2.8.1                    |
| 2  |    |   |   |   |   |   |   |   |   | 3  | 3  |    |     |   | 2   | 1.2.1,1.7.1,2.8.1, 3.6.2, 4.6.1,5.4.1 |
| 3  |    |   |   |   |   |   |   |   |   | 3  | 3  |    |     |   | 3   | 1.2.1,1.7.1, 2.5.2, 5.5.2             |
| 4  |    |   |   |   |   |   |   | 2 |   | 3  | 3  |    |     |   | 3   | 1.2.1,1.7.1, 2.5.2, 5.5.2             |
| 5  |    |   |   |   |   |   |   | 2 |   |    |    |    |     |   | 2   |                                       |

#### COURSE CONTENT

##### UNIT I

1. ***Beginners, Functional, Situational Conversations:*** Introduction, Importance of spoken English in the placements and Group Discussion Beginners Conversation, Self Introduction Introducing Self, Introducing each other in a team (Pair Activity) Functional Conversation, Seeking Permission from Seniors Teachers and other superiors (Team Activity), Asking Direction-Direction from stranger or from Helpline, Making Requests, Requests for borrowing books, applications, or any other help from office staff in college or outside.

2. ***Just a minute***: Give a topic and ask the student to talk impromptu, To present the topic in a structured manner

## UNIT II

3. ***Structuring and forming sentences***: Structure of mother tongue and pit falls in translation to English, Formation of sentences in English.
4. ***Errors in Usage***: Difficulty in right usage of words, Difficulty in Pronunciation- Phonetic differences in mother tongue and English –areas to improve, Idioms and Phrase –Frequently used Idiom and Phrases which help to enhance the quality of presentation and make the presentation meaningful, Meaning of frequently used Idioms and Phrases

## UNIT III

5. ***Introduction to different ways of speaking***: Elocution, Debate and Ex-tempore, Principles of Elocution and its challenges practice in session, Principles of Debates and its challenges – practice session, Principles of Extempore - its pitfalls- practice sessions.

## UNIT IV

6. ***Etiquette***: Need of Etiquette in Social arena, Dining Etiquette, Social Etiquette in conversation -formal and informal gathering, Book a table etc.
7. ***Versant Test***: Mode of versant Test, Aim of the test and various methods it follows, Practice session.

## METHODOLOGY

- Audio—Visuals / Hand Outs (Compiled/Created by Training Division, T&P Cell, VR Siddhartha Engineering College), Board & Chalk and Interactive Sessions.

## Text Books and Reference Books

1. KamaleshSadanand, “A Spoken English”, VOL 1&2; Orient BlackSwan, Second Edition,2014.
2. “Communicative English”; Pearson; 2010.

## 23MC4107

### ENVIRONMENTAL STUDIES

|                 |                              |                   |       |
|-----------------|------------------------------|-------------------|-------|
| Course Category | Mandatory Course             | Credits           | –     |
| Course Type     | Theory                       | L-T-P             | 2-0-0 |
| Prerequisites   | Consciousness of Environment | Continuous Eval   | 100   |
|                 |                              | Semester End Eval | 0     |
|                 |                              | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Identify various factors causing degradation of natural resource and control measures
2. Identify various ecosystem and need for biodiversity
3. Realize and explore the problems related to environmental pollution and its management
4. Apply the information and technology to analyze social issues, use acts associated with environment

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI         |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |             |
| 1  | 1  |   |   |   |   |   |   | 1 |   |    |    |    | 1   |   | 2   | 1.3.1       |
| 2  |    | 1 | 1 |   |   |   |   |   |   | 1  |    |    | 1   |   | 2   | 2.8.1,3.6.2 |
| 3  |    |   |   | 1 | 1 |   |   |   |   |    |    | 1  | 1   |   | 2   | 3.5.2,5.5.2 |
| 4  |    |   |   |   |   | 1 | 1 | 1 |   |    |    |    | 1   |   | 3   |             |

#### COURSE CONTENT

##### UNIT I

***The 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.

- (a) **Forest resources:** Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forests and tribal people
- (b) **Water resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.



- (c) **Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources.
- (d) **Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.
- (e) **Energy resources:** Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.
- (f) **Land resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

## UNIT II

**Ecosystems:** Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem:

- (a) Forest ecosystem
- (b) Grassland ecosystem
- (c) Desert ecosystem
- (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**Biodiversity and Its Conservation:** Introduction, definition: genetic, species and ecosystem diversity. Biogeographically classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

## UNIT III

**Environmental Pollution:** Definition, Causes, effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards.

**Solid waste management:** Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

**Disaster management:** Floods, earthquake, cyclone and landslides.

## UNIT IV

**Social Issues and the Environment:** From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns.

**Environmental ethics:** Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products.

**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:** Human Population and the Environment, Population growth, variation among nations, Population explosion—Family Welfare Programme.

**Environment and human health:** Human rights, Value education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in environment and human health.

**Field Work/ Case Studies:** Visit to a local area to document environmental assets—river/forest/grassland/hill/ mountain. Visit to a local polluted site—Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

**Self Study:** Water resources, Threats to biodiversity, Solid waste management, Role of Information Technology in environment and human health.

## TEXT BOOKS

1. Erach Bharucha, Text book of Environmental Studies for Undergraduate Courses, Universities Press (India) Private Limited, 2019.
2. Palaniswamy, Environmental Studies, 2/e, Pearson education, 2014.
3. S.Azeem Unnisa, Environmental Studies, Academic Publishing Company, 2021.
4. K.Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, SciTech Publications (India), Pvt. Ltd, 2010.

## REFERENCE BOOKS

1. Deeksha Dave and E.Sai Baba Reddy, Textbook of Environmental Science, 2/e, Cengage Publications, 2012.
2. M.Anji Reddy, “Textbook of Environmental Sciences and Technology”, BS Publication, 2014.
3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications, 2006.
4. J. Glynn Henry and Gary W. Heinke, Environmental Sciences and Engineering, Prentice Hall of India Private limited, 1988.
5. G.R. Chatwal, A Text Book of Environmental Studies, Himalaya Publishing House, 2018.
6. Gilbert M. Masters and Wendell P. Ela, Introduction to Environmental Engineering and Science, 1/e, Prentice Hall of India Private limited, 1991.

**E-RESOURCES AND OTHER DIGITAL MATERIALS:**

1. [https://onlinecourses.nptel.ac.in/noc23\\_hs155/preview](https://onlinecourses.nptel.ac.in/noc23_hs155/preview)
2. [https://www.edx.org/learn/environmental-science/rice-university-ap-renvironmental-science-part-3-pollution-andresources?index=product&objectID=course-3a6da9f2-d84c-4773-8388-1b2f8f6a75f2&webview=false&campaign=AP%C2%AE+Environmental+Science+ +Part+3%3A+Pollution+and+Resources&source=edX&product\\_category=course& placement\\_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fenvironmental science](https://www.edx.org/learn/environmental-science/rice-university-ap-renvironmental-science-part-3-pollution-andresources?index=product&objectID=course-3a6da9f2-d84c-4773-8388-1b2f8f6a75f2&webview=false&campaign=AP%C2%AE+Environmental+Science+ +Part+3%3A+Pollution+and+Resources&source=edX&product_category=course& placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fenvironmental+science)
3. <http://ecoursesonline.iasri.res.in/Courses/Environmental%20Science I/Data%20Files/pdf/lec07.pdf>
4. <https://www.youtube.com/watch?v=5QxxaVfgQ3k>

## 23AI&DS4651

### FULL STACK DEVELOPMENT – I

|                 |                         |                   |       |
|-----------------|-------------------------|-------------------|-------|
| Course Category | Skill Oriented Course-1 | Credits           | 1     |
| Course Type     | Laboratory              | L-T-P             | 0-0-2 |
| Prerequisites   | 23PC2104A               | Continuous Eval   | 30    |
|                 | Data Structures         | Semester End Eval | 70    |
|                 |                         | Total Marks       | 100   |

#### COURSE OUTCOMES

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

- 1.
- 2.
- 3.
- 4.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                        |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                            |
| 1  |    |   |   |   |   |   |   |   |   |    |    |    |     |   |     | 1.2.1, 1.7.1, 2.5.1, 4.6.3 |
| 2  |    |   |   |   |   |   |   |   |   |    |    |    |     |   |     | 1.2.1, 2.5.1, 2.5.3, 4.4.1 |
| 3  |    |   |   |   |   |   |   |   |   |    |    |    |     |   |     | 1.2.1, 2.5.3, 4.4.1        |
| 4  |    |   |   |   |   |   |   |   |   |    |    |    |     |   |     | 1.2.1, 2.5.3, 4.4.1        |

#### COURSE CONTENT

1. Lists, Links and Images
  - (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
  - (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, in such a way that, rather than placing large images on a page, the preferred technique is to use thumbnails by setting

the height and width parameters to something like to 100\*100 pixels. Each thumbnail image is also a link to a full sized version of the image. Create an image gallery using this technique

## 2. HTML Tables, Forms and Frames

- (a) Write a HTML program, to explain the working of tables. (use tags: <table>, <tr>, <th>, <td> and attributes: border, rowspan, colspan)
- (b) 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, border, rowspan, colspan etc.)
- (c) 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)
- (d) 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 also make sure of using “no frame” attribute such that frames to be fixed)

## 3. HTML 5 and Cascading Style Sheets, Types of CSS

- (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 apply different types (or levels of styles or style specification formats) - inline, internal, external styles to HTML elements. (identify selector, property and value)

## 4. Selector forms

- (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. Pseudo-class selector
  - iv. Pseudo-element selector
  - v. Attribute selector

## 5. CSS with Color, Background, Font, Text and CSS Box Model

- (a) Write a program to demonstrate the various ways you can reference a color in CSS.
  - (b) 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.
  - (c) Write a program using the following terms related to CSS font and text:
    - i. font-size
    - ii. font-weight
    - iii. font-style
    - iv. text-decoration
    - v. text-transformation
    - vi. text-alignment
  - (d) Write a program, to explain the importance of CSS Box model using
    - i. Content
    - ii. Border
    - iii. Margin
    - iv. padding
6. Applying JavaScript - internal and external, I/O, Type Conversion
- (a) Write a program to embed internal and external JavaScript in a web page
  - (b) Write a program to explain the different ways for displaying output
  - (c) Write a program to explain the different ways for taking input
  - (d) Create a webpage which uses prompt dialogue box to ask a voter for his name and age. Display the information in table format along with either the voter can vote or not
7. JavaScript Pre-defined and User-defined Objects
- (a) Write a program using document object properties and methods
  - (b) Write a program using window object properties and methods
  - (c) Write a program using array object properties and methods
  - (d) Write a program using math object properties and methods
  - (e) Write a program using string object properties and methods
  - (f) Write a program using regex object properties and methods
  - (g) Write a program using date object properties and methods
  - (h) Write a program to explain user-defined object by using properties, methods, accessors, constructors and display.

## 8. JavaScript Conditional Statements and Loops

- (a) 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”.
- (b) Write a program to display week days using switch case.
- (c) Write a program to print 1 to 10 numbers using for, while and do-while loops.
- (d) Write a program to print data in object using for-in, for-each and for-of loops
- (e) Develop a program to determine whether a given number is an ‘ARM-STRONG NUMBER’ or not. [Eg: 153 is an Armstrong number, since sum of the cube of the digits is equal to the number i.e.,  $1^3 + 5^3 + 3^3 = 153$ ]
- (f) Write a program 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)

## 9. Javascript Functions and Events

- (a) Design a appropriate 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
- (b) Design a HTML having a text box and four buttons named Factorial, Fibonacci, Prime, and Palindrome. When a button is pressed an appropriate 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
- (c) Write a program to validate the following fields in a registration page
  - i. Name (start with alphabet and followed by alphanumeric and the length should not be less than 6 characters)
  - ii. Mobile (only numbers and length 10 digits)
  - iii. E-mail (should contain format like xxxxxxxx@xxxxxxx.xxx)

**TEXT BOOKS**

1. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson, 2013.
2. Web Programming with HTML5, CSS and JavaScript, John Dean, Jones & Bartlett Learning, 2019 (Chapters 1-11).
3. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.

**E-RESOURCES AND OTHER DIGITAL MATERIALS:**

1. <https://www.w3schools.com/html>
2. <https://www.w3schools.com/css>
3. <https://www.w3schools.com/js/>
4. <https://www.w3schools.com/nodejs>
5. dhanavanthini@vrsiddhartha.ac.in<https://www.w3schools.com/typescript>



## 23ES4152

### DESIGN THINKING AND INNOVATION

|                 |                     |                   |       |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits           | 2     |
| Course Type     | Theory              | L-T-P             | 1-0-2 |
| Prerequisites   | –                   | Continuous Eval   | 30    |
|                 |                     | Semester End Eval | 70    |
|                 |                     | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Understand the fundamentals of Design Thinking and innovation
2. Apply the design thinking techniques for solving problems in various sectors
3. Analyse to work in a multidisciplinary environment
4. Analyse the value of creativity

***Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)***

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                        |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                            |
| 1  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 2   | 2 | 2   | 1.7.1,2.6.2,2.7.1          |
| 2  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 1   | 2 | 3   | 1.6.1, 1.7.1, 2.6.2, 2.7.1 |
| 3  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 1   | 2 | 4   | 1.6.1, 1.7.1, 2.5.1, 2.7.1 |
| 4  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 1   | 2 | 4   | 1.6.1, 1.7.1, 2.6.2, 2.7.1 |

#### COURSE CONTENT

##### UNIT I

Introduction to Design and Design Thinking, Definition of Design Thinking, Need of Design Thinking, Features of Design Thinking, Problem Solving and Design, Design thinking as Strategy of Innovation, Use of Design Thinking, Design Thinking-Attributes, The Principles of Design Thinking, The Five-step Process of Design Thinking(Empathize, Define, Ideate, Prototype, Test),Design Thinking-A Solution basedthinking: Design Thinking vs. Scientific Method, Problem Focused vs. Solution Focused, Analysis vs.Synthesis, Divergent Thinking vs. Convergent Thinking , Roots of Design Thinking in Human Centric Design Process.

**UNIT II**

**Define:** Define Point of view, “How might we ...” question, Storytelling, Context Mapping, Ideate Brainstorming, 2x2 Matrix.

**Ideate:** Purpose, Methods Tools, SCAMPER, SCAMPER for Ideation, SCAMPER template, Analogous Inspiration, IDEATION using Deconstruct & Reconstruct, User Experience Journey.

**UNIT III**

Get Visual, Design Principals, Determine What to Prototype, Storyboard Prototype- How to carry out Prototyping? Frequently used kinds of prototypes, Focused experiments- Critical Experience Prototype (CEP) Critical Function Prototype (CFP), Crazy experiments –Darkhorse Prototype, Combined experiments – Funky prototype. Prototyping -Paper Prototyping, Digital Prototyping- Wireframe vs Realistic Prototypes, HTML vs WYSIWYG Editors, Additional Tools for Prototyping, Working with a Developer, Prototype Examples.

**UNIT IV**

Test- Testing Sheet, Structured Usability Testing, A/B Testing, Design Testing with Users, Exploring Visual Design Mock-Ups Choosing a Design Testing, Usability Testing, Reflect- I like, I wish, I wonder, Create a pitch, Road map for implementation Evolve- Concept Synthesis, Viability Analysis(Impact Evaluation), Innovation Tool using user needs, CAP, 4s Design Thinking in Healthcare with IDEO, Design Thinking Transformed Airbnb, IBM Design Thinking: A Framework To Help Teams Continuously Understand and Deliver, UberEATS

**TEXT BOOKS**

1. Michael Lewrick, Patrick Link, Larry Leifer , “The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods”, March 2020 edition, ISBN: 978-1-119- 62921-4, WILEY Publication.

**REFERENCE BOOKS**

1. Russ Unger, Carolyn Chandler, “A Project Guide to UX Design For user experience designers in the field or in the making (Voices That Matter)”, 2nd Edition, ISBN 13: 978-0-321-81538-5
2. Karl T Ulrich, “Design – Creation of Artifacts in Society”, 1st edition, ISBN 978-0-9836487-0-3, University of Pennsylvania
3. Tim Brown, “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, ISBN- 9780061937743, Harper Collins, 2009
4. Jeanne Liedtka, Andrew King, Kevin Bennett, “Solving Problems with Design Thinking: Ten Stories Of “What Works””, Columbia Business School Publishing, E-ISBN 978-0-231-53605-9

**E-RESOURCES AND OTHER DIGITAL MATERIALS:**

1. Design Thinking - A Primer online course video lectures by IIT Madras (free-ideolectures.com)
2. Design Thinking Transformed Airbnb: <https://review.firstround.com/How-design-thinkingtransformed-Airbnb-from-failing-startup-to-billion-dollar-business>
3. IBM Design Thinking: A Framework To Help Teams Continuously Understand and Deliver: [https://www.ibm.com/blogs/think/2016/01/ibm-design-thinking-a-framework-for-teams tocontinuously-understand-and-deliver/](https://www.ibm.com/blogs/think/2016/01/ibm-design-thinking-a-framework-for-teams-tocontinuously-understand-and-deliver/)

## 23AI&DS4353

### ARTIFICIAL INTELLIGENCE LABORATORY

|                 |                              |                   |       |
|-----------------|------------------------------|-------------------|-------|
| Course Category | Program Core                 | Credits           | 1.5   |
| Course Type     | Laboratory                   | L-T-P             | 0-0-3 |
| Prerequisites   | 23AI&DS3352                  | Continuous Eval   | 30    |
|                 | Advanced Data Structures and | Semester End Eval | 70    |
|                 | Algorithms Analysis Lab      | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Apply Pandas library to manipulate data structures and visualize data using built-in visualization tools
2. Analyze and implement various search algorithms to solve optimization and path finding problems
3. Evaluate AI problem-solving methods by implementing decision-making algorithms
4. Develop a knowledge base system for reasoning tasks using AI concepts

***Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)***

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                              |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                  |
| 1  | 2  | 2 |   |   | 2 |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.6.1,1.7.1, 2.5.1               |
| 2  | 2  | 2 | 2 |   | 2 |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.6.1, 1.7.1, 2.5.1, 2.5.3       |
| 3  | 2  | 2 | 2 |   | 2 |   |   |   |   |    |    |    | 1   | 1 | 5   | 1.6.1, 1.7.1, 2.7.1, 5.6.1,5.6.2 |
| 4  | 2  | 2 | 2 |   | 2 |   |   |   |   |    |    |    | 1   |   | 5   | 1.6.1, 1.7.1, 3.5.1, 5.6.1,5.6.2 |

#### List of Experiments

##### 1. Pandas Library

- (a) Write a python program to implement Pandas Series with labels
- (b) Create a Pandas Series from a dictionary
- (c) Creating a Pandas Data Frame
- (d) Write a program which makes use of the following Pandas methods

- (i) describe ()
- (ii) head ()
- (iii) tail ()
- (iv) info ()

## 2. **Pandas Library:** Visualization

- (a) Write a program which use pandas inbuilt visualization to plot following graphs:
  - (i) Bar plots
  - (ii) Histograms
  - (iii) Line plots
  - (iv) Scatter plots
- 3. Write a Program to Implement Breadth First Search using Python.
- 4. Write a program to implement Best First Searching Algorithm
- 5. Write a Program to Implement Depth First Search using Python.
- 6. Write a program to implement the Heuristic Search
- 7. Write a python program to implement A\* and AO\* algorithm. (Ex: find the shortest path)
- 8. Write a Program to Implement Water-Jug problem using Python.
- 9. Write a Program to Implement Alpha-Beta Pruning using Python.
- 10. Write a Program to implement 8-Queens Problem using Python.
- 11. Write a program to schedule a meeting among a 5 busy people using Default Reasoning the output should give the time, place and day of the meeting.
- 12. Write a program to implement the Unification algorithm
- 13. Develop a knowledge base system consisting of facts and rules about some specialized knowledge domain
- 14. Write a program to implement 8 puzzle programs using different heuristics. Using it play the game Tic-Tac-Toe at the end the game the program should display the no. of nodes generated, cutoff values at each stage in the form of a table.

**TEXT BOOKS**

1. Prateek Joshi, Artificial Intelligence with Python, Packt Publishing, 2017.
2. Xiao, Perry. Artificial intelligence programming with Python: from zero to hero. John Wiley & Sons, 202.

**REFERENCE BOOKS**

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach, Fourth Edition, Pearson, 2020.
2. Martin C. Brown (Author), “Python: The Complete Reference” McGraw Hill Education, Fourth edition, 2018.
3. R. NageswaraRao , “Core Python Programming” Dreamtech Press India Pvt Ltd 2018.

**E-RESOURCES AND OTHER DIGITAL MATERIALS:**

1. <https://www.coursera.org/learn/ai-for-everyone-> Last Accessed 12-11-2024
2. [https://course.fast.ai/-](https://course.fast.ai/) Last Accessed 12-11-2024
3. <https://www.kaggle.com/learn/intro-to-machine-learning-> Last Accessed 12-11-2024
4. [https://www.upgrad.com/machine-learning-ai-pgd-iiitb-lpv1/-](https://www.upgrad.com/machine-learning-ai-pgd-iiitb-lpv1/)Last Accessed 12-11-2024

## 23AI&DS4354

### DATA SCIENCE USING PYTHON LABORATORY

|                 |                    |                   |       |
|-----------------|--------------------|-------------------|-------|
| Course Category | Program Core       | Credits           | 1.5   |
| Course Type     | Laboratory         | L-T-P             | 0-0-3 |
| Prerequisites   | 23PC2104A          | Continuous Eval   | 30    |
|                 | Data structures    | Semester End Eval | 70    |
|                 | 23AI&DS3651 Python | Total Marks       | 100   |

#### COURSE OUTCOMES

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

1. Apply Numpy library to perform basic data operations
2. Apply Pandas for Data preparation and Exploration
3. Demonstrate data preprocessing and visualization using Python tools
4. Demonstrate Python tools like Sci Kit-Learn, NLTK/Spicy/Py NLPI for NLP

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                                             |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                                 |
| 1  | 1  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 4   | 1.6.1,1.7.1,2.5.1, .5.2, 2.6.3, 2.7.1,3.5.1,3.8.2               |
| 2  | 1  | 2 | 3 |   | 2 |   |   |   |   |    |    |    | 1   | 2 | 4   | 1.6.1,1.7.1,2.5.1, 2.5.2,2.6.4,3.5.1,3.8.2, 5.4.1, 5.4.2        |
| 3  | 1  | 2 | 3 |   | 2 |   |   |   |   |    |    |    | 1   | 2 | 6   | 1.6.1,1.7.1,2.5.1, 2.5.2,2.6.3,3.5.1,3.6.2, 3.8.2, 5.4.1, 5.4.2 |
| 4  | 1  | 2 | 3 |   | 2 |   |   |   |   |    |    |    | 1   | 2 | 6   | 1.6.1,1.7.1,2.5.1, 2.5.2,2.6.3,3.5.1,3.6.2, 3.8.2, 5.4.1, 5.4.2 |

#### COURSE TASKS

##### Task 1

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

**Task 2****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

**Task 3****3. Expanding and Squeezing a NumPy Array**

- (a) Expanding a NumPy array
- (b) Squeezing a NumPy array
- (c) Sorting in NumPy Arrays

**Task 4****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

**Task 5****5. Stacking and Concatenating Numpy Arrays**

- (a) Stacking ndarrays
- (b) Concatenating ndarrayss



- (c) Broadcasting in Numpy Arrays

**Task 6**

- 6. Perform following operations using pandas
  - (a) Creating dataframe
  - (b) concat()
  - (c) Setting conditions
  - (d) Adding a new column

**Task 7**

- 7. Perform following operations using pandas
  - (a) Filling NaN with string
  - (b) Sorting based on column values
  - (c) groupby()

**Task 8**

- 8. Read the following file formats using pandas
  - (a) Text files
  - (b) CSV files
  - (c) Excel files
  - (d) JSON files

**Task 9**

- 9. Read the following file formats
  - (a) Pickle files
  - (b) Image files using PIL
  - (c) Multiple files using Glob
  - (d) Importing data from database

**Task 10**

- 10. Demonstrate web scraping using python

**Task 11**

11. Perform following preprocessing techniques on loan prediction dataset

- (a) Feature Scaling
- (b) Feature Standardization
- (c) Label Encoding
- (d) One Hot Encoding

### **Task 12**

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

### **Task 13**

13. Getting started with NLTK, install NLTK using PIP

### **Task 14**

14. Python program to implement with Python Sci Kit-Learn & NLTK

### **Task 15**

15. Python program to implement with Python NLTK/Spicy/Py NLPI

## **TEXT BOOKS**

- 1. Davy Cielen, Arno D.B.Meysman, and Mohamed Ali, “Introducing to Data Science using Python tools”, Manning Publications Co, Dreamtech press, 2016.
- 2. Prateek Gupta, “Data Science with Jupyter” BPB publishers, 2019 for basics.

## **REFERENCE BOOKS**

- 1. Python Data Science Handbook <https://jakevdp.github.io/PythonDataScience-Handbook>, Last accessed on 12-11-2024.
- 2. Free interactive course on machine learning fundamentals. <https://developers.google.com/machine-learning/crash-course> Last accessed on 12-11-2024.
- 3. Tutorials - Getting Started - Neo4j Graph Data Platform

4. Best Online Hadoop Courses and Programs - edX

**E-RESOURCES AND OTHER DIGITAL MATERIALS:**

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-exploration-python/6>.
6. <https://www.nltk.org/book/ch01.html>

## SEMESTER V

## 23AI&DS5301

### DATA WAREHOUSING AND DATA MINING

|                 |                     |                   |       |
|-----------------|---------------------|-------------------|-------|
| Course Category | PC                  | Credits           | 3     |
| Course Type     | Theory              | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS3304         | Continuous Eval   | 30    |
|                 | Database Management | Semester End Eval | 70    |
|                 | Systems             | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand fundamental concepts of and techniques of data warehousing and data mining.
2. Apply various pre-processing techniques in Data mining.
3. Analyze classification and apriori algorithms to solve real life problems.
4. Analyze different types of clustering algorithms to solve real life problems.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                               |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                   |
| 1  | 3  |   |   |   |   |   |   |   |   |    |    |    | 3   | 2 | 2   | 1.2.1, 1.7.1                      |
| 2  | 1  | 3 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1 |
| 3  | 1  | 3 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1 |
| 4  | 1  | 2 |   |   |   |   |   |   |   |    |    |    | 2   | 2 | 4   | 1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1 |

#### COURSE CONTENT

##### UNIT I

**Introduction to Data Warehousing:** Data Warehousing and Online Analytical Processing: Basic concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Cloud Data Warehouse, Data Mining and Pattern Mining, Technologies, Applications Major Issues in Data Mining.

**Getting to Know your data:** Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity.

##### UNIT II

**Data Preprocessing:** An Overview; Data Cleaning- Missing Values, Noisy data.

Integration: Entity Identification problem, Redundancy and Correlation Analysis.

**Data Reduction:** Overview of Data Reduction Strategies, Wavelet Transformation, Principal Components Analysis; Attribute Subset selection.

**Data Transformation and Data Discretization:** Data Transformation Strategies Overview, Data Transformation by Normalization, Discretization by Binning.

### UNIT III

**Association Analysis:** Problem Definition, Frequent Itemset Generation, Rule Generation: Confident Based Pruning, Rule Generation in Apriori Algorithm, Compact Representation of frequent item sets, FP-Growth Algorithm.

**Classification:** Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Attribute Selection Measures, Tree Pruning, Scalability and Decision Tree Induction, Visual Mining for Decision Tree Induction.

### UNIT IV

**Cluster Analysis:** Overview, Basics and Importance of Cluster Analysis, Clustering techniques, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Bi-secting K Means, Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses. (Text Book- 2).

### TEXTBOOKS

1. Jiawei Han, Michel Kamber, Data Mining concepts and Techniques, 3rd edition, Elsevier, 2011.
2. Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Introduction to Data Mining, 2nd Edition, Pearson, 2012.

### REFERENCE BOOKS

1. VikramPudi and P. Radha Krishna, Data Mining, 1st Edition, Oxford Publisher, 2009.
2. Arun K Pujari, Data Mining Techniques, 3rd edition, Universities Press, 2013.

### E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. PabitraMitra, Data Mining, [https://onlinecourses.nptel.ac.in/noc22\\_cs11/preview](https://onlinecourses.nptel.ac.in/noc22_cs11/preview), Last accessed on: 25/04/2025.
2. Dr. Saed Sayad, An Introduction to Data Science, [http://www.saedsayad.com/data\\_mining\\_map.html](http://www.saedsayad.com/data_mining_map.html), Last accessed on: 25/04/2025.

## 23AI&DS5302

### PRINCIPLES OF MACHINE LEARNING

|                 |                     |                   |       |
|-----------------|---------------------|-------------------|-------|
| Course Category | PC                  | Credits           | 3     |
| Course Type     | Theory              | L-T-P             | 3-0-0 |
| Prerequisites   | 223BS4101A          | Continuous Eval   | 30    |
|                 | Statistical methods | Semester End Eval | 70    |
|                 | for Data science    | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the fundamentals of Machine Learning and build Nearest neighbour based models.
2. Apply models based on Decision trees and Bayes rule.
3. Analyze the use of Linear discriminants for machine Learning.
4. Analyze appropriate clustering technique.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                               |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                   |
| 1  | 2  | 1 |   |   |   |   |   |   |   |    |    |    | 2   | 2 | 2   | 1.2.1, 1.7.1, 2.5.2               |
| 2  | 1  | 3 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1 |
| 3  | 1  | 3 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1 |
| 4  | 1  | 2 |   |   |   |   |   |   |   |    |    |    | 2   | 2 | 4   | 1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1 |

#### COURSE CONTENT

##### UNIT I

**Introduction to Machine Learning:** : Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Data Sets.

**Nearest Neighbor-Based Models:** Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, KNN Classifier, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

## UNIT II

**Models Based on Decision Trees:** Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression. **The Bayes Classifier:** Introduction to the Bayes Classifier, Bayes’ Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification — Class Conditional Independence and Naive Bayes Classifier (NBC)

## UNIT III

**Linear Discriminants for Machine Learning:** Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.

## UNIT IV

**Clustering:** Introduction to Clustering, Partitioning of Data, Matrix Factorization — Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

## TEXTBOOKS

1. M. N. Murthy and V. S. Ananthanarayana, Machine Learning: Theory and Practice, 1st ed. Hyderabad, India: Universities Press (India), 2024.

## REFERENCE BOOKS

1. T. M. Mitchell, Machine Learning, 1st edition, New York, NY, USA: McGraw-Hill, 2017.
2. P. Harrington, Machine Learning in Action, 1st edition, New Delhi, India: DreamTech Press, 2012.
3. P.-N. Tan, M. Steinbach, and V. Kumar, Introduction to Data Mining, 7th edition, Pearson, 2019.

## E-RESOURCES AND OTHER DIGITAL MATERIALS

1. A. Ng, Machine Learning, Stanford University, Available: <https://cs229.stanford.edu/>, Last Accessed on: 02/05/2025.
2. R. Barzilay, Introduction to Machine Learning, MIT OpenCourseWare, 2020, [Online]. Available: <https://ocw.mit.edu/courses/6-036-introduction-to-machine-learning-fall-2020/>, Last Accessed on: 02/05/2025.
3. User Guide, scikit-learn, Available: [https://scikit-learn.org/stable/user\\_guide.html](https://scikit-learn.org/stable/user_guide.html), Last Accessed on: 02/05/2025.



## 23AI&DS5303

### OPERATING SYSTEMS

|                 |                 |                   |       |
|-----------------|-----------------|-------------------|-------|
| Course Category | PC              | Credits           | 3     |
| Course Type     | Theory          | L-T-P             | 3-0-0 |
| Prerequisites   | 23ES1104        | Continuous Eval   | 30    |
|                 | Introduction to | Semester End Eval | 70    |
|                 | Programming     | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the basic components of an Operating System.
2. Apply CPU Scheduling techniques and mechanisms used for process synchronization.
3. Analyse Memory management techniques and methods for handling deadlocks.
4. Analyse File system Implementation techniques and protection mechanisms.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                      |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                          |
| 1  | 3  |   |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.7.1                                    |
| 2  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4, 3.7.1 |
| 3  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 4   | 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1 |
| 4  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 4   | 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1 |

#### COURSE CONTENT

##### UNIT I

**System Structures:** Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, operating system Design and Implementation, operating system structure, Building and Booting an Operating System, Operating system debugging.

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

**Threads and Concurrency:** Multithreading models, Thread libraries, threading issues.

## UNIT II

**CPU Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, multiple processor scheduling.

**Synchronization Tools:** The Critical Section Problem, Peterson's Solution, Mutex Locks, Semaphores, Monitors, Classic problems of Synchronization.

## UNIT III

**Deadlocks:** system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

**Memory-Management Strategies:** Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping.

**Virtual Memory Management:** Introduction, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing.

**Storage Management:** Overview of Mass Storage Structure, HDD Scheduling.

## UNIT IV

**File System:**File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method.

**Free space management:** File-System Internals: File-System Mounting, Partitions and Mounting, File Sharing.

**Protection:**Goals of protection, Principles of protection, Protection Rings, Domain of protection, Access matrix.

## TEXTBOOKS

1. Silberschatz A, Galvin P B, Gagne G, Operating System Concepts, Wiley, 10<sup>th</sup> Edition, 2018.
2. Tanenbaum A S, Modern Operating Systems, Galgotia Publications Pvt. Ltd, 4<sup>th</sup> Edition, 2016.

## REFERENCE BOOKS

1. Stallings W, Operating Systems -Internals and Design Principles, Pearson, 9<sup>th</sup> Edition, 2018.
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach, McGraw- Hill, 3<sup>rd</sup> Edition, 2013.

## E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof Santanu Chattopadhyay - NPTEL Course on Operating Sytems, <https://nptel.ac.in/courses/106/105/106105214/>, Last Accessed On: 28/04/2025.
2. Stanford University - Lecture Notes on Operating Systems, <https://www.scs.stanford.edu/21wi-cs140/notes>, Last Accessed on: 28/04/2025.
3. IIT Bombay – Lecture Notes on Operating Systems , <https://www.cse.iitb.a>

`c.in/~mythili/os/`, Last Accessed on: 28/04/2025.

## 23AI&DS5404A

### SOFTWARE ENGINEERING

|                 |        |                   |       |
|-----------------|--------|-------------------|-------|
| Course Category | PE-I   | Credits           | 2     |
| Course Type     | Theory | L-T-P             | 3-0-0 |
| Prerequisites   | -      | Continuous Eval   | 30    |
|                 |        | Semester End Eval | 70    |
|                 |        | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the different software engineering process models.
2. Apply analysis model for different applications.
3. Apply design model for different application.
4. Apply different testing techniques.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                      |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                          |
| 1  | 2  | 3 |   |   |   |   |   |   |   |    |    |    | 2   | 2 | 2   | 1.7.1, 2.5.1, 2.5.2, 2.6.4, 2.7.1        |
| 2  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 3   | 1.7.1, 2.5.1, 2.7.1, 3.5.1, 3.5.2, 3.5.6 |
| 3  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 3   | 1.7.1, 2.5.1, 2.6.4 3.5.1, 3.8.1         |
| 4  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 2   | 3 | 3   | 1.7.1, 2.5.1, 2.6.4 3.5.1, 3.6.2, 3.8.2  |

#### COURSE CONTENT

##### UNIT I

**The Nature of Software:** The Nature of Software, The changing nature of software. Software engineering: The Software Process, Software Engineering Practice, Software Development Myths.

**The Software Process:** Software Process Structure. A Generic Process Model, Defining a framework activity, identifying a task set, Process patterns, Process Assessment and Improvement. Process models: Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models.

**Agile Development:** Agility and the Cost of Change, Extreme Programming (XP) Other Agile Process Models, A Tool Set for the Agile Process.

##### UNIT II

**Understanding Requirements:** Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Analysis Model, Negotiating Requirements, Requirements monitoring, and Validating Requirements.

**Requirements Modeling:** Scenario Based Methods: Requirements Analysis, Scenario-Based Modeling, UML Models That Supplement the Use Case. Class based methods, Identifying Analysis classes, specifying attributes, Defining operators, Class-Responsibility-Collaborator Modeling, Associates and Dependencies, Analysis Packages.

**Behavior, Patterns, And Web apps:** Creating a Behavioral Model, identifying events with Use Cases, State Representations, Patterns for Requirements Modeling, Requirements Modeling for Web and Mobile Apps.

### UNIT III

**Design Concepts:** Design within the Context of Software Engineering, the Design Process, Design Concepts, the Design Model.

**Architectural Design:** Software Architecture, Architectural Genres, Architectural Styles, Architectural Considerations, Architectural Decisions, Architectural Design. Component-Level Design: Designing Class-Based Components, Conducting Component Level Design, and Component level design for Web Apps, Component Level Design for Mobile Apps.

**User Interface Design:** The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Web app and Mobile Interface Design

### UNIT IV

**Software Testing Strategies:** A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object-Oriented Software, Test Strategies for Web Apps, Test Strategies for Mobile Apps, Validation testing, System testing, the art of debugging. **Testing Conventional Applications:** Software Testing Fundamentals, Internal and External Views of Testing, White Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing.

### TEXTBOOKS

1. Roger S. Pressman, Bruce R. Maxim, Software Engineering a practitioners approach" 8<sup>th</sup> Edition, McGraw-Hill Publication 2019.

### REFERENCE BOOKS

1. Ian Sommerville, Software Engineering, 9<sup>th</sup> Edition, Pearson Education. 2011.
2. Software Engineering principles and practice- Waman S Jawadekar, The Mc Graw Hill Companies.
3. Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education.

### E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Software Engineering Course, [https://www.tutorialspoint.com/software\\_engineering/index.htm](https://www.tutorialspoint.com/software_engineering/index.htm), Last Accessed on: 12/04/2025.
2. Prof. Rajib Mall, IIT Kharagpur, Software Engineering, <https://archive.nptel.ac.in/courses/106/105/106105182/> Last Accessed On: 12/04/2025.

## 23AI&DS5404B

### RECOMMENDER SYSTEMS

|                 |        |                   |       |
|-----------------|--------|-------------------|-------|
| Course Category | PE -I  | Credits           | 3     |
| Course Type     | Theory | L-T-P             | 3-0-0 |
| Prerequisites   |        | Continuous Eval   | 30    |
|                 |        | Semester End Eval | 70    |
|                 |        | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand basic concepts behind recommender systems
2. Analyze a variety of approaches for building recommender systems
3. Apply system evaluation methods from both algorithmic and users perspectives
4. Apply applications of recommender systems in various domains

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                               |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                   |
| 1  | 2  | 3 |   |   |   |   |   |   |   |    |    |    | 1   |   | 2   | 1.2.2, 1.6.1, 1.7.1, 2.5.1, 2.5.2 |
| 2  | 2  | 3 |   |   |   |   |   |   |   |    |    |    | 1   |   | 4   | 1.2.2, 1.6.1, 1.7.1, 2.5.1, 2.6.3 |
| 3  | 2  | 3 |   |   |   |   |   |   |   |    |    |    | 1   |   | 3   | 1.2.2, 1.6.1, 1.7.1, 2.6.3        |
| 4  | 2  | 3 |   |   |   |   |   |   |   |    |    |    | 1   |   | 3   | 1.2.2, 1.6.1, 1.7.1, 2.5.1        |

#### COURSE CONTENT

##### UNIT I

**Introduction:** Recommender system functions, Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

**Collaborative Filtering:** User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems.

##### UNIT II

**Content-based recommendation:** High level architecture of content-based sys-

tems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

**Knowledge based recommendation:** Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.

### UNIT III

**Hybrid approaches:** : Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies.

### UNIT IV

**Evaluating Recommender System:** Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centered metrics.

**Recommender Systems and communities:** Communities, collaboration and recommender systems in personalized web search, Social tagging recommender systems, Trust and recommendations.

### TEXTBOOKS

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press, 1st edition, 2011.
2. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer, 1st edition, 2011.

### REFERENCE BOOKS

1. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer, 1st edition, 2013.

### E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Mamata Jenamani, <https://nptel.ac.in/courses/127105390>, Last Accessed on: 02/04/25.



## 23AI&DS5404C

### INFORMATION RETRIEVAL SYSTEMS

|                 |                    |                   |       |
|-----------------|--------------------|-------------------|-------|
| Course Category | PE-I               | Credits           | 3     |
| Course Type     | Theory             | L-T-P             | 3-0-0 |
| Prerequisites   | 20AI&DS3304        | Continuous Eval   | 30    |
|                 | Database           | Semester End Eval | 70    |
|                 | Management Systems | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the overview of information Retrieval
2. Apply different techniques for compression of an index including the dictionary and its posting list
3. Apply appropriate method for text classification or clustering
4. Understand the basics of web search

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                             |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                 |
| 1  | 2  | 2 | 1 |   |   |   |   |   |   |    |    |    |     | 1 | 2   | 1.2.1,1.2.2,1.6.1,1.7.1                         |
| 2  | 2  |   | 2 | 3 | 2 |   |   |   |   |    |    |    |     | 1 | 3   | 2.5.1,2.6.4,2.7.1,4.6.1                         |
| 3  | 2  | 1 | 2 | 3 |   |   |   |   |   |    |    |    |     | 1 | 3   | 1.2.1,1.2.2,1.6.1,1.7.1,2.5.1,2.6.4,2.7.1,4.6.1 |
| 4  | 2  | 2 | 1 |   |   |   |   |   |   |    |    |    |     | 1 | 2   | 1.2.1,1.6.1,1.7.1,2.8.1                         |

#### COURSE CONTENT

##### UNIT I

***Fundamentals of Information Retrieval(IR), Models and Index construction and compression:*** Boolean retrieval, The term vocabulary and postings lists, Dictionaries and tolerant retrieval, Index construction and compression, Scoring, term weighting, and the vector space model, Computing scores in a complete search system, Introduction to Relevance feedback and query expansion.

***Probabilistic information retrieval:*** Review of basic probability theory, The probability ranking principle, The binary independence model.

***Language models for information retrieval:*** Language modeling versus other approaches in information retrieval

## UNIT II: Text Classification

**Text classification and Naive Bayes:** The text classification problem, Naive Bayes text classification, Properties of Naive Bayes, The Bernoulli model, Feature selection, Evaluation of text classification.

**Vector space classification:** Document representations, Measures of relatedness in vector spaces, Rocchio classification, k nearest neighbour, Linear versus nonlinear classifiers, Classification with more than two classes. Support vector machines (SVM) and machine learning on documents, Evaluation in information retrieval.

## UNIT III: Text Clustering, Matrix decompositions and latent semantic indexing

**Flat clustering:** Clustering in information retrieval, Problem statement, Evaluation of clustering, K-means, Model-based clustering.

**Hierarchical clustering:** Hierarchical agglomerative clustering, Single-link and complete-link clustering, Group-average agglomerative clustering, Centroid clustering, Optimality of hierarchical agglomerative clustering, Divisive clustering, Cluster labelling.

**Matrix decompositions and latent semantic indexing:** Term-document matrices and singular value decompositions, Low-rank approximations, Latent semantic indexing.

## UNIT IV: Web Information Retrieval

**Web search basics:** Web search basics, Web characteristics, Index size and estimation, Near duplicates and shingling **Web Crawling and Indexes:** Crawling, Distributing Indexes, Connectivity servers. **Link Analysis:** Web as a graph, PageRank, Hubs and authorities.

## TEXTBOOKS

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, “An Introduction to Information Retrieval”, Cambridge University Press, 2008.

## REFERENCE BOOKS

1. Stefan Büttcher, Charles L. Clarke, Gordon V. Cormack, “Information Retrieval: Implementing and evaluating search engines”, MIT Press, 2010
2. David A. Grossman, Ophir Frieder, “Information Retrieval: Algorithms and Heuristics”, Springer, 2004
3. Frakes, “Information Retrieval: Data Structures and Algorithms”, Pearson, 2009

## E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Information Retrieval and Web Search <https://web.stanford.edu/class/cs276/> (Last accessed on 12-11-2022)

## 23AI&DS5404D

### EXPLORATORY DATA ANALYSIS WITH PYTHON

|                 |                                         |                   |       |
|-----------------|-----------------------------------------|-------------------|-------|
| Course Category | PE-I                                    | Credits           | 3     |
| Course Type     | Theory                                  | L-T-P             | 2-0-2 |
| Prerequisites   | 23AI&DS3651 -<br>Python Programming Lab | Continuous Eval   | 30    |
|                 |                                         | Semester End Eval | 70    |
|                 |                                         | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Apply exploratory data analysis techniques using statistical and visualization tools to interpret and present different types of data effectively.
2. Apply data transformation techniques to prepare, analyze, and interpret datasets.
3. Apply descriptive statistical methods and grouping techniques to analyze and organize datasets effectively.
4. Analyze data using correlation and multivariate techniques and examine patterns in time series data.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                        |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                            |
| 1  | 1  | 2 |   |   | 3 |   |   |   |   |    |    |    | 1   | 2 | 3   | 1.2.1, 2.5.3, 5.4.1        |
| 2  |    | 1 | 2 | 3 |   |   |   |   |   |    |    |    | 1   | 2 | 3   | 2.6.3, 3.6.2, 4.6.1        |
| 3  |    | 1 | 2 |   | 3 |   |   |   |   |    |    |    | 1   | 2 | 3   | 2.5.3, 2.6.3, 3.6.2, 5.4.2 |
| 4  |    | 3 | 1 |   | 2 |   |   |   |   |    |    |    | 1   | 2 | 4   | 2.8.2, 3.8.2, 5.5.1        |

#### COURSE CONTENT

##### UNIT I

**Exploratory Data Analysis Fundamentals:** Understanding data science, The significance of EDA, Making sense of data – Numerical data; Categorical data; Measurement scales, Comparing EDA with classical and Bayesian analysis, Software tools available for EDA. Getting started with EDA – NumPy; Pandas; SciPy; Matplotlib.

**Visual Aids for EDA:** : Line chart, Bar charts, Scatter plot – Bubble chart; Scatter plot using seaborn, Area plot and stacked plot, Pie chart, Table chart, Polar chart, Histogram, Lollipop chart, Choosing the best chart.

Sample Experiments:

1. a) Download Dataset from Kaggle using the following link : <https://www.kaggle.com/datasets/sukhmanibedi/cars4u>

- b) Install python libraries required for Exploratory Data Analysis (numpy, pandas, matplotlib, seaborn)
2. Perform Numpy Array basic operations and Explore Numpy Built-in functions.
3. Loading Dataset into pandas dataframe.
4. Selecting rows and columns in the dataframe.
5. Apply different visualization techniques using sample dataset
  - a.) Line Chart b.) Bar Chart c.) Scatter Plots d.) Bubble Plot
6. Apply following visualization Techniques for a sample dataset
  - a.) Area Plot b.) Stacked Plot c.) Pie chart d.) Table Chart

## UNIT II

**EDA with Personal Email:** Data transformation – Data cleansing; Loading the CSV file; Converting the date; Removing NaN values; Applying descriptive statistics; Data refactoring; Dropping columns; Refactoring timezones, Data analysis.

**Data Transformation:** Merging database-style data frames, Transformation techniques – Performing data deduplication; Replacing values; Handling missing data; Renaming axis indexes; Discretization and binning; Outlier detection and filtering; Permutation and random sampling, Benefits of data transformation.

Sample Experiments:

1. Perform the following operations
  - a) Merging Dataframes b) Reshaping with Hierarchical Indexing c) Data Deduplication d) Replacing Values
2. Apply different Missing Data handling techniques
  - a) NaN values in mathematical Operations b) Filling in missing data c) Forward and Backward filling of missing values d) Filling with index values e) Interpolation of missing values
3. Apply different data transformation techniques
  - a) Renaming axis indexes b) Discretization and Binning c) Permutation and Random Sampling d) Dummy variables

## UNIT III

**Descriptive Statistics:** Understanding statistics – Distribution function; Cumulative distribution function; Descriptive statistics, Measures of central tendency – Mean/average; Median; Mode, Measures of dispersion – Standard deviation; Variance; Skewness; Kurtosis; Calculating percentiles; Quartiles.

**Grouping Datasets:** Understanding groupby(), Groupby mechanics – Selecting a subset of columns; Max and min; Mean, Data aggregation – Group-wise operations; Group-wise transformations, Pivot tables and cross-tabulations – Pivot tables; Cross-tabulations.

Sample Experiments:

1. Study the following Distribution Techniques on a sample data
  - a) Uniform Distribution b) Normal Distribution c) Gamma Distribution d) Exponential Distribution e) Poisson Distribution f) Binomial Distribution
2. Perform Data Cleaning on a sample dataset.
3. Compute measure of Central Tendency on a sample dataset

- a) Mean b)Median c)Mode
- 4. Explore Measures of Dispersion on a sample dataset
- a) Variance b) Standard Deviation c) Skewness d) Kurtosis

## UNIT IV

**Correlation:**Introducing correlation, Types of analysis – univariate analysis; bivariate analysis; multivariate analysis, Discussing multivariate analysis using the Titanic dataset, Outlining Simpson’s paradox.

**Time Series Analysis:** Understanding the time series dataset – Fundamentals of TSA; Characteristics of time series data, TSA with Open Power System Data – Data cleaning; Time-based indexing; Visualizing time series; Grouping time series data; Resampling time series data.

Sample Experiments:

- 1. a) Calculating percentiles on sample dataset b) Calculate Inter Quartile Range(IQR) and Visualize using Box Plots
- 2. Perform the following analysis on automobile dataset.
- a) Bivariate analysis b)Multivariate analysis 3. Perform Time Series Analysis on Open Power systems dataset

## TEXTBOOKS

- 1. Suresh Kumar Mukhiya, Usman Ahmed, Hands-On Exploratory Data Analysis with Python, Packt Publishing, 1st Edition, 2020.

## REFERENCE BOOKS

- 1. Ronald K. Pearson, Exploratory Data Analysis Using R, CRC Press, 1st Edition, 2020.
- 2. Radhika Datar, Harish Garg, Hands-On Exploratory Data Analysis with R: Become an expert in exploratory data analysis using R packages, 1st Edition, Packt Publishing, 2019.

## E-RESOURCES AND OTHER DIGITAL MATERIALS:

- 1. Prof. Ragunathan Rengasamy, Python for Data Science [https://onlinecourses.nptel.ac.in/noc22\\_cs32/preview](https://onlinecourses.nptel.ac.in/noc22_cs32/preview), Last Accessed on: 25/04/2025.
- 2. Exploratory Data Analysis in Python, <https://www.udemy.com/course/exploratory-data-analysis-in-python/>, Last Accessed on: 25/04/2025.

## 23AI&DS5205A

### WEB PROGRAMMING

|                 |        |                   |       |
|-----------------|--------|-------------------|-------|
| Course Category | OE- I  | Credits           | 3     |
| Course Type     | Theory | L-T-P             | 3-0-0 |
| Prerequisites   | –      | Continuous Eval   | 30    |
|                 |        | Semester End Eval | 70    |
|                 |        | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the concepts of Web designing.
2. Apply the concepts of HTML5 and CSS to design static web pages.
3. Apply client side technologies to design interactive Web interfaces
4. Apply interactive server side scripting for a web application.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                               |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                   |
| 1  | 3  | 2 |   |   |   |   |   |   |   |    |    |    |     |   | 2   | 1.3.1, 2.1.1                      |
| 2  |    | 2 | 3 |   |   |   |   |   |   |    |    |    | 2   |   | 3   | 2.2.3, 3.2.1, 3.2.2               |
| 3  |    | 2 | 3 |   |   |   |   |   |   |    |    |    | 3   |   | 3   | 2.2.3, 2.2.4, 3.3.1, 3.2.1, 3.2.2 |
| 4  |    | 2 | 3 |   |   |   |   |   |   |    |    |    | 3   |   | 3   | 2.2.3, 3.2.1, 3.2.2               |

#### COURSE CONTENT

##### UNIT I

**Introduction:** Concept of WWW, Internet and WWW, HTTP Protocol : Request and Response, Web browser and Web servers, Features of Web 2.0.

**Web Design:** Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation.

##### UNIT II

**HTML:** Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of HTML5.

**Style sheets:** Need for CSS, introduction to CSS, basic syntax and structure, using

CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of CSS3

### UNIT III

**JavaScript:** Client side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: Javascript and objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations, DHTML : Combining HTML, CSS and Javascript, Events and buttons.

**XML:** Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Using XML with application. Transforming XML using XSL and XSLT.

### UNIT IV

**PHP:** Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP.

**PHP and MySQL:** Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs.

### TEXT BOOKS

1. R. Moseley and M. T. Savaliya, Developing Web Applications, 2nd ed. New Delhi, India: Wiley India Pvt. Ltd., 2011.

### REFERENCE BOOKS

1. J. Sklar, Web Design Principles, 5th edition, Boston, MA: Course Technology Cengage Learning, 2012.
2. H. M. Deitel, P. J. Deitel, and T. R. Nieto, Internet & World Wide Web: How to Program, 3rd edition, Upper Saddle River, NJ: Pearson/Prentice Hall, 2004.
3. B. M. Harwani, Developing Web Applications in PHP and AJAX. New Delhi, India: Tata McGraw-Hill Education, 2010.

### E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Sengupta, Internet Technology, NPTEL, Jun. 28, 2014. <https://nptel.ac.in/courses/106105084>, Last Accessed: 05/05/2025.
2. PHP Group, PHP: MySQL - Manual, PHP: Hypertext Preprocessor, <https://www.php.net/manual/en/book.mysql.php>, Last Accessed: 05/05/2025.

## 23AI&DS5205B

### INTERNET OF THINGS

|                 |        |                   |       |
|-----------------|--------|-------------------|-------|
| Course Category | OE- I  | Credits           | 3     |
| Course Type     | Theory | L-T-P             | 3-0-0 |
| Prerequisites   |        | Continuous Eval   | 30    |
|                 |        | Semester End Eval | 70    |
|                 |        | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the design concepts and applications of Internet of Things
2. Understand Standards and Key Technologies in IoT.
3. Apply the steps of the design methodology in developing IoT applications using Raspberry Pi
4. Understand the Privacy, security and Vulnerabilities of internet of Things

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                 |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                     |
| 1  | 2  |   |   |   |   |   |   |   |   |    |    |    | 1   | 2 | 2   | 1.6.1,1.7.1         |
| 2  | 2  |   |   |   |   |   |   |   |   |    |    |    | 1   | 2 | 2   | 1.6.1, 1.7.1        |
| 3  |    | 2 | 2 |   |   |   |   |   |   |    |    |    | 2   |   | 3   | 2.7.1, 2.7.2, 3.6.2 |
| 4  | 1  |   |   |   | 2 |   |   |   |   |    |    |    |     |   | 2   | 1.6.1, 1.7.1, 5.4.1 |

#### COURSE CONTENT

##### UNIT I

**Introduction to Internet of things:** Introduction, Physical design of IoT, Logical Design of IoT, IoT Enabling technologies, IoT levels & Deployment templates.

**Domain Specific IoTs** – Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle

##### UNIT II

**IoT and M2M:** Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization.

**IoT Platforms Design Methodology:** Introduction, IoT Design Methodology, Case Study on IoT System for Home Automation , IoT system for Weather Monitoring.

##### UNIT III



***IoT Physical Devices and Endpoints:*** Basic building blocks of an IoT Device, Introduction to Raspberry Pi Board, Linux on Raspberry Pi, Raspberry Pi Interfaces (serial, SPI, I2C)

***Programming Raspberry PI with Python*** – Controlling LED with Raspberry Pi, Interfacing an LED and Switch with Raspberry Pi, Interfacing a Light sensor (LDR) with Raspberry Pi.

#### UNIT IV

***IoT Privacy, Security and Vulnerabilities Solutions:*** Introduction, Vulnerabilities, Security Requirements and Threat Analysis – Privacy, Vulnerabilities of IoT, Security Requirements, Threat Analysis, Use Cases and Misuse Cases, IoT Security Tomography and Layered Attacker model. Security models, profiles and protocols for IoT.

#### TEXTBOOKS

1. Arshdeep Bahga , Vijay Madisetti, Internet of Things (A Hands-on Approach), 1<sup>st</sup> Edition, Universities Press Private Limited, 2014.
2. Raj Kamal, Internet of Things, Architecture and Design Principles, 1<sup>st</sup> Edition, McGraw Hill Education Private Limited, 2017.

#### REFERENCE BOOKS

1. Matt Richardson & Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly (SPD), 2014.
2. David Hanes, IOT Fundamentals, 1<sup>st</sup> Edition, CISCO Press, 2018.

#### E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sudip Misra, IIT Kharagpur, Introduction to Internet of things, Available: <https://nptel.ac.in/courses/106/105/106105166/>, Last Accessed on: 24/04/2025.
2. Prof. T V Prabhakar, IISc Bangalore, Design for Internet of things, Available: <https://nptel.ac.in/courses/108/108/108108098/>, Last Accessed on: 24/04/2025.

## 23AI&DS5205C

### MOBILE APPLICATION DEVELOPMENT

|                 |        |                   |       |
|-----------------|--------|-------------------|-------|
| Course Category | OE- I  | Credits           | 3     |
| Course Type     | Theory | L-T-P             | 3-0-0 |
| Prerequisites   |        | Continuous Eval   | 30    |
|                 |        | Semester End Eval | 70    |
|                 |        | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the fundamentals of Android Operating System.
2. Apply UI principles to develop interfaces for Android platform.
3. Apply mobile application concepts to deploy and publish a given app into android device.
4. Apply principles to develop a database connection for a given mobile application.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                                           |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                               |
| 1  | 2  | 2 |   |   |   |   |   |   |   |    |    |    |     |   | 2   | 1.7.1, 2.5.1, 2.5.2, 2.7.1                                    |
| 2  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.7.1, 3.5.1                      |
| 3  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4 3.5.1, 3.8.2                |
| 4  |    | 2 | 3 | 2 | 2 |   |   |   |   |    |    |    | 2   | 2 | 3   | 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 3.6.2, 3.8.2, 4.6.2, 5.4.2 |

#### COURSE CONTENT

##### UNIT I

**Introduction to Android:** An open platform for mobile development, Native android applications, Android SDK Features, Introducing the Development Framework, Downloading and Installing the Android SDK, Creating your First Android Application, Types of Android Applications, Developing for Mobile and Embedded devices, Android Development Tools.

**Creating Applications and Activities:** Introducing the Application Manifest File, Externalizing Resources, The Android Application Lifecycle, A Closer look at Android Activities.

## UNIT II

**Building User Interfaces:** Fundamental Android UI Design, Android User Interface fundamentals, Introducing Layouts.

**User Interface (UI) Components:** Editable and non-editable TextViews, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers.

**Event Handling:** Handling clicks or changes of various UI components.

## UNIT III

**Introducing Fragments:** Creating New Fragments, The Fragment Lifecycle, Introducing the Fragment Manager, Adding Fragments to Activities, Interfacing Between Fragments and Activities, Fragments Without User Interfaces.

**Introducing Adapters:** Introducing Some Native Adapters, Customizing the Array Adapter, Using Adapters to Bind Data to a View. **Introducing Intents:** Using intents to launch activities, Introducing Linkify, Using Intents to broadcast Events, Notifications – Creating and Displaying notifications, Displaying Toasts.

## UNIT IV

**Creating Intent Filters and Broadcast Receivers:** Using Intent Filters to Service Implicit Intents, Using Intent Filters for Plug-Ins and Extensibility, Listening for Native.

**Working with SQLite Databases:** Introducing the SQLiteOpenHelper, Opening and Creating Databases without SQLite Open Helper, Android Database design considerations, Querying a Database, Extracting values from a cursor, Adding, Updating and Removing Rows.

## TEXTBOOKS

1. R. Meier, Professional Android 4 Application Development, 3rd ed. Indianapolis, IN, USA: Wiley India (Wrox), 2012.

## REFERENCE BOOKS

1. D. Griffiths and D. Griffiths, Head First Android Development: A Brain-Friendly Guide, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, Inc., 2017.
2. J. C. Sheusi, Android Application Development for Java Programmers. Boston, MA, USA: Cengage Learning, 2013.
3. W.-M. Lee, Beginning Android 4 Application Development. Indianapolis, IN, USA: Wiley India (Wrox), 2012.
4. B. Phillips, C. Stewart, B. Hardy, and K. Marsicano, Android Programming: The Big Nerd Ranch Guide, 3rd ed. Atlanta, GA, USA: Big Nerd Ranch LLC, 2017.

## E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Mehmet Ongel, Build Real Android Apps: Android 11 App Development: Java, <https://www.udemy.com/course/build-real-android-apps-android-app-development-with-java/>, Last Accessed on: 24/04/2025.

2. Courseera : Dr. Jerry Roth, Android App Development Specialization, Department of Computer Science and Electrical Engineering, Vanderbilt University <https://www.coursera.org/specializations/android-app-development>, Last Accessed on: 24/04/2025.

## 23AI&DS5351

### DATA WAREHOUSING AND MACHINE LEARNING LAB

|                 |                              |                   |       |
|-----------------|------------------------------|-------------------|-------|
| Course Category | PC                           | Credits           | 1     |
| Course Type     | Laboratory                   | L-T-P             | 0-0-2 |
| Prerequisites   | 23AI&DS3304                  | Continuous Eval   | 30    |
|                 | Data Base Management Systems | Semester End Eval | 70    |
|                 |                              | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Apply techniques of data warehousing and data mining.
2. Apply various pre-processing techniques on datasets using Data mining techniques.
3. Analyze classification and apriori algorithms to solve real life problems.
4. Analyze different types of clustering algorithms to solve real life problems.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                      |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                          |
| 1  | 3  |   |   |   | 2 |   |   |   |   |    |    |    | 3   | 2 | 3   | 1.2.1, 1.7.1, 5.4.2                      |
| 2  | 1  | 3 |   |   | 2 |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1, 5.4.2 |
| 3  | 1  | 3 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.2.1, 1.7.1, 2.5.2                      |
| 4  | 1  | 2 |   |   |   |   |   |   |   |    |    |    | 2   | 2 | 4   | 1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1        |

**Software Requirements:** WEKA Tool/Python/R-Tool/Rapid Tool/Oracle Data mining

#### COURSE CONTENT

**Task 1:** Creation of a Data Warehouse.

- Build Data Warehouse/Data Mart (using open source tools like Pentaho Data Integration Tool, Pentaho Business Analytics; or other data warehouse tools like Microsoft-SSIS, Informatica, Business Objects, etc.,)
- Design multi-dimensional data models namely Star, Snowflake and Fact Constellation schemas for any one enterprise (ex. Banking, Insurance, Finance, Healthcare, manufacturing, Automobiles, sales etc).
- Write ETL scripts and implement using data warehouse tools.

- Perform Various OLAP operations such slice, dice, roll up, drill up and pivot

**Task 2:** Explore machine learning tool “WEKA”

- Explore WEKA Data Mining/Machine Learning Toolkit.
- Downloading and/or installation of WEKA data mining toolkit.
- Understand the features of WEKA toolkit such as Explorer, Knowledge Flow interface, Experimenter, command-line interface.
- Navigate the options available in the WEKA (ex. Select attributes panel, Preprocess panel, Classify panel, Cluster panel, Associate panel and Visualize panel)
- Study the arff file format Explore the available data sets in WEKA. Load a data set (ex. Weather dataset, Iris dataset, etc.)
- Load each dataset and observe the following: 1. List the attribute names and they types 2. Number of records in each dataset 3. Identify the class attribute (if any) 4. Plot Histogram 5. Determine the number of records for each class. 6. Visualize the data in various dimensions

**Task 3:** Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets

- Explore various options available in Weka for preprocessing data and apply Unsupervised filters like Discretization, Resample filter, etc. on each dataset
- Load weather. nominal, Iris, Glass datasets into Weka and run Apriori Algorithm with different support and confidence values.
- Study the rules generated. Apply different discretization filters on numerical attributes and run the Apriori association rule algorithm. Study the rules generated.
- Derive interesting insights and observe the effect of discretization in the rule generation process.

**Task 4:** Demonstrate performing classification on data sets Weka/R

- Load each dataset and run 1d3, J48 classification algorithm. Study the classifier output. Compute entropy values, Kappa statistic.
- Extract if-then rules from the decision tree generated by the classifier, Observe the confusion matrix.
- Load each dataset into Weka/R and perform Naïve-bayes classification and k-Nearest Neighbour classification. Interpret the results obtained.
- Plot RoC Curves
- Compare classification results of ID3, J48, Naïve-Bayes and k-NN classifiers for each dataset, and deduce which classifier is performing best and poor for each dataset and justify.

**Task 5:** Demonstrate performing clustering of data sets

- Load each dataset into Weka/R and run simple k-means clustering algorithm with different values of k (number of desired clusters).
- Study the clusters formed. Observe the sum of squared errors and centroids, and derive insights.
- Explore other clustering techniques available in Weka/R.
- Explore visualization features of Weka/R to visualize the clusters. Derive interesting insights and explain.

**Task 6:** Demonstrate knowledge flow application on data sets into Weka/R

- Develop a knowledge flow layout for finding strong association rules by using Apriori, FP Growth algorithms
- Set up the knowledge flow to load an ARFF (batch mode) and perform a cross validation using J48 algorithm
- Demonstrate plotting multiple ROC curves in the same plot window by using j48 and Random forest tree

**Task 7:** Demonstrate ZeroR technique on Iris dataset (by using necessary preprocessing technique(s)) and share your observations

**Task 8:** Write a java program to prepare a simulated data set with unique instances.

**Task 9:** Write a Python program to generate frequent item sets / association rules using Apriori algorithm

**Task 10:** Write a program to calculate chi-square value using Python/R. Report your observation.

**Task 11:** Write a program of Naive Bayesian classification using Python/R programming language

**Task 12:** Implement a Java/R program to perform Apriori algorithm

**Task 13:** Write a R program to cluster your choice of data using simple k-means algorithm using JDK

**Task 14:** Write a program of cluster analysis using simple k-means algorithm Python/R programming language.

**Task 15:** Write a program to compute/display dissimilarity matrix (for your own dataset containing at least four instances with two attributes) using Python

**Task 16:** Visualize the datasets using matplotlib in python/R.(Histogram, Box plot, Bar chart, Pie chart etc.,)

## TEXTBOOKS

1. Jiawei Han, Michel Kamber, Data Mining concepts and Techniques, 3rd edition, Elsevier, 2011.
2. Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Introduction to Data Mining, 2nd edition, Pearson, 2012.

**REFERENCE BOOKS**

1. VikramPudi and P. Radha Krishna, Data Mining, 1st Edition, Oxford Publisher.
2. Arun K Pujari, Data Mining Techniques, 3rd edition, Universities Press, 2013.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Prof. PabitraMitra, Data Mining Techniques, [https://onlinecourses.nptel.ac.in/noc22\\_cs11/preview](https://onlinecourses.nptel.ac.in/noc22_cs11/preview), Last accessed on: 25/04/2025.
2. Dr. Saed Sayad, An Introduction to Data Science, [http://www.saedsayad.com/data\\_mining\\_map.html](http://www.saedsayad.com/data_mining_map.html), Last accessed on: 25/04/2025.



# SEMESTER VI

**23AI&DS6301****NATURAL LANGUAGE PROCESSING & DEEP LEARNING**

|                 |                                            |                   |       |
|-----------------|--------------------------------------------|-------------------|-------|
| Course Category | Program Core                               | Credits           | 3     |
| Course Type     | Theory                                     | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS5302:Principles of Machine learning | Continuous Eval   | 30    |
|                 |                                            | Semester End Eval | 70    |
|                 |                                            | Total Marks       | 100   |

**COURSE OUTCOMES**

1. Apply language models and text processing techniques for NLP tasks.
2. Analyze POS tagging and sequence modeling methods for effective word-level analysis.
3. Understand the deep learning approaches and paradigms
4. Apply Recurrent Neural Networks(RNN) and Convolutional Neural Networks CNN for feature learning tasks.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                      |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                          |
| 1  | 3  | 2 | 1 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.7.1,2.6.4,3.7.1                        |
| 2  | 3  | 2 | 1 |   |   |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4, 3.7.1 |
| 3  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 2   | 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1 |
| 4  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 3   | 1.7.1,2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1  |

**COURSE CONTENT****UNIT I**

**NLP Introduction:**Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

**UNIT II**

**Word Level Analysis:**Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy Models.

### UNIT III

**Basics:** Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm.

**Feed forward Networks:** Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, auto encoders. Deep Neural Networks: Difficulty of training deep neural networks, Greedy layer wise training.

### UNIT IV

**Recurrent Neural Networks:** Back propagation through time, Long ShortTerm Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.

**Convolutional Neural Networks:** LeNet, AlexNet. Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines, Transformers, Attention models, Embeddings.

### TEXTBOOKS

1. Daniel Jurafsky, James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2nd Edition, Pearson, 2014.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 1st Edition, MIT Press, 2016.

### REFERENCE BOOKS

1. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, 1st Edition, O'Reilly Media, 2009.
2. Raúl Rojas, Neural Networks: A Systematic Introduction, 1st Edition, Springer, 1996.
3. Christopher M. Bishop, Pattern Recognition and Machine Learning, 1st Edition, Springer, 2007.
4. François Chollet, Deep Learning with Python, 1st Edition, Manning Publications, 2017.
5. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, 1st Edition, Atlantic Publishers, 2015.
6. Richard M. Reese, Natural Language Processing with Java, 2nd Edition, O'Reilly Media, 2015.

### E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sudharshan Iyengar, Department of Computer Science and Engineering, IIT Ropar, and Prof. Mitesh M. Khapra, Department of Computer Science and Engineering, IIT Madras, NPTEL Course: Natural Language Processing, <https://nptel.ac.in/courses/106106184> , Last Accessed On: 27/10/2025.
2. Prof. Prabir Kumar Biswas, Department of Electronics and Electrical Engineering,

IIT Kharagpur, NPTEL Course, [https://onlinecourses.nptel.ac.in/noc20\\_cs62/preview](https://onlinecourses.nptel.ac.in/noc20_cs62/preview) , Last Accessed On: 01/11/2025.

## 23AI&DS6302

### BIG DATA ANALYTICS

|                 |                                                      |                         |       |
|-----------------|------------------------------------------------------|-------------------------|-------|
| Course Category | Program Core                                         | Credits                 | 3     |
| Course Type     | Theory                                               | L-T-P                   | 3-0-0 |
| Prerequisites   | 23AI&DS3307:Object Oriented Programming Through Java | Continuous Evaluation   | 30    |
|                 |                                                      | Semester End Evaluation | 70    |
|                 |                                                      | Total Marks             | 100   |

### COURSE OUTCOMES

1. Understand the concepts of Big Data Analytics and Hadoop components used for managing big data.
2. Apply Hadoop MapReduce programs to perform distributed data processing.
3. Apply Pig and Hive tools to process, manage, and analyze structured and unstructured data in Hadoop.
4. Apply Spark and Sqoop concepts to handle and analyze large-scale data in Hadoop.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                     |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                         |
| 1  | 3  | 2 | 1 |   |   |   |   |   |   |    |    |    | 3   | 2 | 2   | 1.6.1,1.7.1,2.7.1,3.5.1 |
| 2  | 1  | 3 | 2 |   |   |   |   |   |   |    |    |    | 3   | 3 | 3   | 1.6.1, 2.6.1, 3.8.2     |
| 3  |    | 1 | 2 | 3 |   |   |   |   |   |    |    |    | 3   | 3 | 3   | 2.8.2, 3.7.1, 4.6.1     |
| 4  |    | 2 | 1 |   | 3 |   |   |   |   |    |    |    | 3   | 3 | 3   | 2.8.1, 3.8.3, 5.5.2     |

### COURSE CONTENT

#### UNIT I

**Introduction to Big Data Analytics:** Big Data Overview – Data Structures, Analyst perspective on Data Repositories, State of the Practice in Analytics – BI versus Data Science, Current analytical architecture, Drivers of big data, Emerging big data ecosystem and a new approach to analytics, Key Roles for the New Big Data Ecosystem, Examples of Big Data Analytics.

**Hadoop Distributed File System:** The Design of HDFS, HDFS concepts, Command-Line Interface, Hadoop File systems, The Java Interface, Data Flow.

#### UNIT II

**MapReduce:** Anatomy of a MapReduce Job Run – Mapper, Reducer, Combiner, Partitioner, Failures, Shuffle and Sort, MapReduce Features: Counters – Built-in counters, User defined counters, Sorting – Partial sort, Total sort, Secondary sort, Joins – Map-Side joins, Reduce-Side joins.

**UNIT III**

**Pig:** Installation and Running of Pig, Execution Types, Running Pig Programs, Comparison with databases, Pig Latin – Structure, Statements, Expressions, Types, Schemas, Functions, Macros, Data processing operators.

**Hive:** Hive services, The Meta-store, HiveQL – Data types, Operators and Functions, Tables – Managed tables and External tables, Partitions and Buckets, Storage Formats, Querying Data – Sorting and Aggregating.

**UNIT IV**

**Spark:** Introduction to Spark Concept, Spark installation, Spark Applications, Jobs Stages and Tasks Spark RDD (Resilient Distributed Dataset) , Creation, Transformations and Actions, Persistence, Serialization, Anatomy of Spark Job Run, Job Submission, DAG construction, Task Scheduling, Task Execution.

**Sqoop:** Sqoop Connectors-Text and Binary File Formats, Sqoop Import Process - Incremental imports, Direct Mode Imports, Importing large objects, Export using MapReduce.

**TEXTBOOKS**

1. David Dietrich, Barry Heller, Beibei Yang, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, 1st Edition, John Wiley & Sons, 2015.
2. Tom White, Hadoop: The Definitive Guide, 4th Edition, O'Reilly Media, 2015.

**REFERENCE BOOKS**

1. Chuck Lam, Hadoop in Action, 1st Edition, Manning Publications, 2010.
2. Dirk de Roos, Paul C. Zikopoulos, Roman B. Melnyk, Bruce Brown, Rafael Coss, Hadoop For Dummies, 1st Edition, Wiley Publishing, 2014.
3. Alex Holmes, Hadoop in Practice, 2nd Edition, Manning Publications, 2015.
4. Dr. A. Krishna Mohan, Dr. E. Laxmi Lydia, Big Data Analytics, 1st Edition, McGraw Hill Education, 2016.
5. S. Perera, T. Gunarathne, Hadoop MapReduce Cookbook, 1st Edition, Packt Publishing, 2013.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Prof. A Ramesh, IIT Roorkee, NPTEL Course: Data Analytics with Python, <https://nptel.ac.in/courses/106107220> , Last Accessed On: 03/10/2025.
2. Prof. Nandan Sudarsanam and Prof. Balaraman Ravindran, IIT Madras, NPTEL Course: Introduction to Data Analytics, <https://nptel.ac.in/courses/110106072> , Last Accessed On: 05/11/2025.
3. Prof. Dr. Mohit Bhatnagar, O.P. Jindal Global University, Coursera Course: Big Data Analytics, <https://www.coursera.org/learn/big-data-analytics-1> , Last Accessed On: 25/10/2025.
4. Prof. Gerald BALEKAKI and Ming-Long Lam, Illinois Tech, Coursera Specialization:

Data Analytics and Big Data, <https://www.coursera.org/specializations/data-analytics-and-big-data> , Last Accessed On: 26/11/2025.

## 23AI&DS6303

### COMPUTER NETWORKS

|                 |                               |                   |       |
|-----------------|-------------------------------|-------------------|-------|
| Course Category | Program Core                  | Credits           | 3     |
| Course Type     | Theory                        | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS5303:Operating Systems | Continuous Eval   | 30    |
|                 |                               | Semester End Eval | 70    |
|                 |                               | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand the concepts related to network categories, topologies, and reference models.
2. Analyze error and flow control mechanisms in data link layer
3. Analyse subnetting and various routing protocols of network layer
4. Analyze transport layer and application layer protocols for specific applications.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                        |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                            |
| 1  | 2  | 3 |   |   |   |   |   |   |   |    |    |    | 1   | 3 | 2   | 1.2.1,1.6.1,1.7.1,2.5.2    |
| 2  | 2  | 3 |   |   |   |   |   |   |   |    |    |    | 1   | 3 | 4   | 1.6.1, 1.7.1, 2.5.2, 2.6.4 |
| 3  | 2  | 3 |   |   |   |   |   |   |   |    |    |    | 1   | 3 | 4   | 1.7.1, 2.5.2, 2.6.4        |
| 4  | 2  | 3 |   |   |   |   |   |   |   |    |    |    | 1   | 3 | 4   | 1.6.1, 1.7.1, 2.5.2, 2.6.4 |

### COURSE CONTENT

#### UNIT I

**Introduction:** Network Types, LAN, MAN, WAN, Network Topologies Reference models- The OSI Reference Model- the TCP/IP Reference Model- A Comparison of the OSI and TCP/IP Reference Models, OSI Vs TCP/IP.

**Physical Layer:** Introduction to Guided Media- Twisted-pair cable, Coaxial cable and Fiber optic cable and introduction about unguided media.

#### UNIT II

**Data link layer:** Design issues, Framing: fixed size framing, variable size framing, flow control, error control, error detection and correction codes, CRC, Checksum:idea, one's complement internet checksum, services provided to Network Layer.

**Elementary Data Link Layer protocols:** Simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel.

**Sliding Window Protocol:** One bit, Go back N, Selective repeat-Stop and wait



protocol, Data link layer in HDLC, Point to point protocol (PPP).

**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).

**Wired LANs:** Ethernet, Ethernet Protocol, Standard Ethernet, Fast Ethernet (100Mbps), Gigabit Ethernet, 10 Gigabit Ethernet.

### UNIT III

**The Network Layer Design Issues:** Store and Forward Packet Switching-Services Provided to the Transport layer, Implementation of Connectionless Service, Implementation of Connection Oriented Service, Comparison of Virtual Circuit and Datagram Networks.

**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.

**Internet Working:** How networks differ- How networks can be connected- Tunneling, internetwork routing-, Fragmentation, network layer in the internet- IP protocols-IP Version 4 protocol-IPV4 Header Format, IP addresses, Class full Addressing, CIDR, Subnets-IP Version 6-The main IPV6 header, Transition from IPV4 to IPV6, Comparison of IPV4 & IPV6.

### UNIT IV

**The Transport Layer:**Transport layer protocols: Introduction-services- port number- User data gram protocol-User datagram-UDP services-UDP applications Transmission control protocol: TCP services- TCP features- Segment- A TCP connection windows in TCP- flow control-Error control, Congestion control in TCP.

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

### TEXTBOOKS

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, 5th Edition, Pearson Education, 2011.
2. Behrouz A. Forouzan, Data Communications and Networking, 4th Edition, Tata McGraw-Hill, 2007.

### REFERENCE BOOKS

1. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 6th Edition, Pearson Education, 2012.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Prof. Sowmya Kanti Ghosh, IIT Kharagpur, NPTEL Course: Computer Networks and Internet Protocol, Video Lectures, <https://nptel.ac.in/courses/106105183> , Last Accessed On: 18/08/2025.
2. Prof. Hari Balakrishnan, MIT OpenCourseWare, MIT, Course: Computer Networks, Video Lectures, <https://ocw.mit.edu/courses/6-829-computer-networks-fall-2002/> , Last Accessed On: 15/09/2025.
3. Dheeraj, IIT Kharagpur, Lecture Notes: Computer Networks, <http://www.cse.iitk.ac.in/users/dheeraj/cs425> , Last Accessed On: 20/10/2025.

## 23AI&DS6404A

### AI FOR INDUSTRIAL APPLICATIONS

|                 |                                     |                   |       |
|-----------------|-------------------------------------|-------------------|-------|
| Course Category | PE II                               | Credits           | 3     |
| Course Type     | Theory                              | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS4302:Artificial Intelligence | Continuous Eval   | 30    |
|                 |                                     | Semester End Eval | 70    |
|                 |                                     | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the AI subfields and Current trends in AI.
2. Understand the AI's vital role in Agriculture 5.0.
3. Apply various AI techniques in Industry applications and expose how Huawei AI framework works.
4. Analyze the role of AI in Generative AI and Bias & Fairness in AI system.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                                                     |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-------------------------------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                                         |
| 1  | 3  |   |   |   |   |   |   |   |   |    |    |    | 1   | 2 | 2   | 1.2.1,1.2.2,1.6.1                                                       |
| 2  | 3  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   | 2 | 2   | 1.6.1,1.7.1,2.5.1, 2.5.2,2.5.3,2.7.1, 2.7.2,2.8.1,3.8.1 3.8.2           |
| 3  | 3  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   | 3 | 3   | 1.6.1, 1.7.1, 2.5.1 2.5.2, 2.5.3, 2.7.1 2.7.2, 2.8.1, 3.8.1 3.8.2       |
| 4  | 3  | 2 | 2 | 1 |   |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.6.1, 1.7.1, 2.5.1 2.5.2, 2.5.3, 2.7.1 2.7.2, 2.8.1,3.8.1 3.8.2, 4.4.1 |

#### COURSE CONTENT

##### UNIT I

**AI Subfields:** Computer Vision: Object detection, facial recognition, scene understanding, prominent application of computer vision, Robotics: components of a Robot, types of Robots, Sophia.

**Current Trends in AI:** AI and Ethical Concerns, AI as a Service (AIaaS), Expert System, Internet of Things, Artificial Intelligence of Things (AIoT).

**UNIT II**

**Industrial revolution:** AI driven smart agriculture– Lifecycle of an AI based model, Prerequisites for building an AI based agriculture model, Advantages. Scope of AI & ML in agriculture, Applications of AI & ML in agriculture. Data driven smart farming– Collection and management of real time agricultural big data, Transforming field data into meaningful insights, Processing and predictive analysis of agricultural data.

**Case Study:** Analyse John Deere See Spray Technology

**UNIT III**

**Industrial Applications of AI:** Application of AI in Healthcare, Application of AI in Finance, Application of AI in Retail, Application of AI in Education, Application of AI in Transportation.

**Huawei Framework:** Huawei AI Open platform, Introduction, Architecture of Huawei AI platform, Part of Huawei AI solutions.

**Case Study:** Analyse China Southern Power Grid defect and risk-identification on power-line inspections using Huawei AI.

**UNIT IV**

**AI in Research, Generative AI and Other important issues:** AI in Experimentation and Multi-disciplinary research, Introduction to Generative AI, ChatGPT and prompt engineering, AI and Social inequality.

**Bias and Fairness in AI Systems:** Ethics in AI, types of bias and fairness measuring and detecting bias, transparency in AI systems.

**Case Study:** AI-driven course generation using ChatGPT.

**TEXTBOOKS**

1. Saptarsi Goswami, Amit Kumar Das, Amlan Chakrabarti, AI for Everyone: A Beginner's Handbook for Artificial Intelligence, 1st Edition, Pearson, 2024.
2. Reema Thareja, Artificial Intelligence: Beyond Classical AI, 1st Edition, Pearson Education, 2023.
3. Huawei Technologies Co., Ltd., Artificial Intelligence Technology, 1st Edition, Springer, 2023, ISBN 978-981-19-2879-6, Available at: <https://doi.org/10.1007/978-981-19-2879-6>.
4. Latief Ahmad, Firasath Nabi, AGRICULTURE 5.0: Artificial Intelligence, IoT and Machine Learning, 1st Edition, CRC Press, Taylor & Francis, 2021, ISBN 978-0-367-64610-3.

**REFERENCE BOOKS**

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Prentice Hall, 2003.
2. Tom Taulli, Prompt Engineering for Generative AI: ChatGPT, LLMs, and Beyond, 1st Edition, Apress, Springer Nature, 2024.

3. Nilakshi Jain, Artificial Intelligence: Making A System Intelligent, 1st Edition, Wiley, 2023.
4. Ajantha Devi Vairamani, Anand Nayyar, Prompt Engineering: Empowering Communication, 1st Edition, CRC Press, Taylor Francis Group, 2024, Available at: <https://doi.org/10.1201/9781032692319>.
5. Konstantinos Kyprianidis, Erik Dahlquist, AI and Learning Systems: Industrial Applications and Future Directions, 1st Edition, IntechOpen, London, United Kingdom, 2021.

## **E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. NPTEL Course: Artificial Intelligence in Industrial and Management Engineering, Last Accessed On: 02/09/2025.
2. Elements of AI, <https://www.elementsofai.com> , Last Accessed On: 06/09/2025.
3. Google, Machine Learning Crash Course, <https://developers.google.com/machine-learning/crash-course> , Last Accessed On: 02/10/2025.
4. Learn Prompting (Open-Source Guide), <https://learnprompting.org> , Last Accessed On: 04/10/2025.
5. Google AI, Learn with Google AI, <https://ai.google/education/> , Last Accessed On: 02/08/2025.
6. OpenAI, Prompt Engineering Guide (for ChatGPT), <https://platform.openai.com/docs/guides/gpt-best-practices> , Last Accessed On: 07/09/2025.
7. DeepLearning.AI and OpenAI, Prompt Engineering for Developers, <https://www.deeplearning.ai/short-courses/chatgpt-prompt-engineering-for-developers/> , Last Accessed On: 07/09/2025.
8. Google, Ethics in AI: Responsible AI Practices, <https://ai.google/responsibilities/responsible-ai-practices/> , Last Accessed On: 10/08/2025.
9. Google, Teachable Machine (Train AI Models Visually Without Code), <https://teachablemachine.withgoogle.com> , Last Accessed On: 02/11/2025.

## 23AI&DS6404B

### DATA VISUALIZATION

|                 |                                                                                            |                                                     |                 |
|-----------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------|
| Course Category | PE II                                                                                      | Credits                                             | 3               |
| Course Type     | Theory                                                                                     | L-T-P                                               | 3-0-0           |
| Prerequisites   | 23AI&DS4303: Introduction to Data Science<br>23AI&DS5301: Data Warehousing and Data Mining | Continuous Eval<br>Semester End Eval<br>Total Marks | 30<br>70<br>100 |

### COURSE OUTCOMES

1. Understand the fundamentals of data visualization, visual perception, Gestalt principles, and information overload.
2. Understand visualization models, visual mapping, visual analytics, and visualization design principles.
3. Apply suitable visualization techniques for multidimensional, text, and structured data.
4. Analyze advanced visualization techniques for volumetric, spatial, GIS, and collaborative data.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                                                               |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                                                   |
| 1  | 2  |   |   |   |   |   |   |   |   |    |    |    |     | 1 | 2   | 1.6.1, 1.7.1                                                                      |
| 2  | 2  | 2 |   |   |   |   |   |   |   |    |    |    |     | 1 | 2   | 1.6.1, 1.7.1<br>2.6.1, 2.6.2, 2.6.3                                               |
| 3  | 2  | 3 | 2 |   | 1 |   |   |   |   |    |    |    |     | 2 | 3   | 1.6.1, 1.7.1, 2.5.1<br>2.5.2, 2.6.3, 2.6.4<br>3.5.1, 3.6.1, 3.6.2<br>5.4.1        |
| 4  | 2  | 3 | 2 |   | 2 |   |   |   |   |    |    |    |     | 2 | 4   | 1.6.1, 1.7.1, 2.5.1<br>2.5.2, 2.6.3, 2.8.2<br>3.5.1, 3.6.1, 3.6.2<br>5.4.1, 5.4.2 |

### COURSE CONTENT

#### UNIT I

**Introduction:** What Is Visualization? History of Visualization, Relationship between Visualization and Other Fields. The Visualization Process, Introduction of

visual perception, visual representation of data, Gestalt principles, information overloads.

## UNIT II

**Principles and Techniques of Data Visualization:** Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications. Classification of visualization systems, Interaction and visualization techniques misleading.

## UNIT III

**Advanced Visualization Techniques:** Visualization of one, two and multi-dimensional data, text and text documents. Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization.

## UNIT IV

**Scientific and Geographic Visualization Techniques:** Visualization of volumetric data, vector fields, processes and simulations, visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations.

**Recent Trends in Visualization:** Recent Trends in various perception techniques, various visualization techniques, data structures in data visualization.

## TEXTBOOKS

1. Ward, M. O., Grinstein, G., Keim, D., Interactive Data Visualization: Foundations, Techniques, and Applications, AK Peters/CRC Press, 2010.
2. Tufte, E. R., Graves-Morris, P. R., The Visual Display of Quantitative Information, Vol. 2, No. 9, Graphics Press, 1983.

## REFERENCE BOOKS

1. Munzner, T., Visualization Analysis and Design, 1st Edition, A K Peters/CRC Press, 2014.
2. Ware, C., Information Visualization: Perception for Design, Morgan Kaufmann, 2020.
3. Fry, B., Visualizing Data: Exploring and Explaining Data with the Processing Environment, O'Reilly Media, 2007.
4. Spence, R., Information Visualization, 2nd Edition, Prentice Hall, 2007.

## E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Hart, J. C., Data Visualization [Video], Coursera, <https://www.coursera.org/learn/datavisualization> , Last Accessed On: 18/12/2025.
2. Granell, C., Mastering Data Visualization: Theory and Foundations [Video], Udemy, January 2023, [https://www.udemy.com/course/mastering-data-visualization/?srsltid=AfmBOoqRCWhaJcQC0ZJ-iuDV11YMj70r81ID\\_PaiGkguXhG3qsqSKD9B&couponCode=CM251218G1](https://www.udemy.com/course/mastering-data-visualization/?srsltid=AfmBOoqRCWhaJcQC0ZJ-iuDV11YMj70r81ID_PaiGkguXhG3qsqSKD9B&couponCode=CM251218G1) , Last Accessed On: 18/12/2025.

3. Data Visualisation Guide, <https://data.europa.eu/apps/data-visualisation-guide/> , Last Accessed On: 18/12/2025.



## 23AI&DS6404C

### SOFT COMPUTING

|                 |                                            |                   |       |
|-----------------|--------------------------------------------|-------------------|-------|
| Course Category | PE II                                      | Credits           | 3     |
| Course Type     | Theory                                     | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS5302:Principles of Machine Learning | Continuous Eval   | 30    |
|                 |                                            | Semester End Eval | 70    |
|                 |                                            | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand the soft computing techniques and models of neural networks.
2. Understand supervised learning networks in solving problems.
3. Apply fuzzy inference systems and fuzzy relations for real time applications.
4. Apply genetic algorithm to solve computer science applications.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                  |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                      |
| 1  | 1  | 1 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.2.1,1.6.1,1.7.1,2.5.3              |
| 2  | 2  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.2.1,1.6.1,1.7.1,2.5.3, 2.6.4,3.5.1 |
| 3  | 2  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.2.1,1.6.1,1.7.1,2.5.3,3.5.1        |
| 4  | 2  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.2.1,1.6.1,1.7.1,2.5.3, 2.6.4       |

### COURSE CONTENT

#### UNIT I

**Introduction to Soft Computing:** Concept of computing, “Soft” computing versus “Hard” computing, Characteristics of soft computing, Types of soft computing, Applications of soft computing techniques.

**Artificial Neural network:** Biological neurons, Basic models of neural networks Connections Learning ,Activation Function, McCulloch and Pitts Neuron ,Hebb network.

#### UNIT II

**Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets:** Introduction of Fuzzy logic, Crisp sets, Operations, Union, Intersection, Complement, Difference, Properties of Classical sets, Function mapping of Classical sets, Fuzzy sets, Operations, Union, Intersection, Complement, Properties of Fuzzy sets.

**Classical Relations and Fuzzy Relations:** Introduction, Cartesian product of Relation, Classical Relation, Cardinality, Operations, Properties, Composition, Fuzzy relations, Cardinality, Operations, Properties, Composition.

### UNIT III

**Membership Function:** Introduction, Features of the Membership Functions, Fuzzification.

**Fuzzy Rule Base and Approximate Mapping:** Introduction, Fuzzy Reasoning, Categorical reasoning, Qualitative reasoning, Syllogistic reasoning, Dispositional reasoning, Fuzzy Inference system, Construction and Working Principle of FIS, Methods of FIS, Mamdani FIS, Takagi-Sugeno Fuzzy Model, Comparison between Mamdani and Sugeno Method.

**Rough sets:** Fundamentals of Rough Set Theory, Rough Approximations, Properties of approximations, Complement, Union, Intersection of Rough sets, Rough Membership Function, Difference between Fuzzy sets and Rough sets.

### UNIT IV

**Genetic Algorithms:** Basic Terminology in Genetic Algorithms, Individuals, Genes, Fitness, Populations, Simple GA, Generic Genetic Algorithm, Operations of Genetic Algorithm, Encoding, Selection, Crossover, Mutation, Stopping Condition in Generic Algorithm, Constraints in Genetic Algorithm.

**Hybrid Systems:** (World): Sequential, Auxiliary, Embedded hybrid systems, Fuzzy Neural systems, Genetic Fuzzy systems, Genetic Neural system.

### TEXTBOOKS

1. S. N. Sivanandam, S. N. Deepa, Principles of Soft Computing, 3rd Edition, John Wiley & Sons, 2019.
2. S. Rajasekaran, G. V. Pai, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications, 1st Edition, PHI Learning Pvt. Ltd., 2007.

### REFERENCE BOOKS

1. N. K. Sinha, M. M. Gupta, Soft Computing & Intelligent Systems: Theory & Applications, 1st Edition, Academic Press / Elsevier, 2009.
2. B.K Tripathy and J.Anuradha ,Soft Computing Advances and Applications Cengage Learning ,2015.
3. R. Eberhart, Y. Shi, Computational Intelligence: Concepts to Implementation, 1st Edition, Morgan Kaufman / Elsevier, 2007.
4. D. Driankov, H. Hellendoorn, M. Reinfrank, An Introduction to Fuzzy Control, 1st Edition, Narosa Publishing House, 2001.
5. Bart Kosko, Neural Networks and Fuzzy Systems, 1st Edition, Prentice Hall, Inc., Englewood Cliffs, 1992.
6. David E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, 1st Edition, Addison-Wesley, 1989.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. D. Samanta, NPTEL Online Course: Introduction to Soft Computing, Apr. 3, 2018, <https://onlinecourses.nptel.ac.in/noc22cs54/preview> , Last Accessed On: 02/09/2025.
2. M. Wall, GAlib: A C++ Library of Genetic Algorithm Components, Massachusetts Institute of Technology, Aug. 1996, <http://lancet.mit.edu/ga/dist/galibdoc.pdf> , Last Accessed On: 20/10/2025.

## 23AI&DS6404D COMPUTER VISION

|                 |                                    |                   |       |
|-----------------|------------------------------------|-------------------|-------|
| Course Category | PE II                              | Credits           | 3     |
| Course Type     | Theory                             | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS3651:Python Programming lab | Continuous Eval   | 30    |
|                 |                                    | Semester End Eval | 70    |
|                 |                                    | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand image formation, radiometry, shading, and color representation in computer vision
2. Apply filtering, transforms, texture analysis, and feature extraction for image processing.
3. Apply multi-view geometry and segmentation methods for scene and object understanding.
4. Apply model fitting, tracking, and camera calibration techniques in vision applications.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                               |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                   |
| 1  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 1   | 2 | 2   | 1.6.1, 1.7.1, 2.6.1, 2.6.2                        |
| 2  | 2  | 3 | 2 |   |   |   |   |   |   |    |    |    | 1   | 2 | 3   | 1.6.1, 1.7.1, 2.6.1<br>2.6.2, 3.5.1               |
| 3  | 2  | 3 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 3   | 1.2.1, 1.6.1, 2.5.3, 2.6.3<br>2.6.4, 3.5.1, 3.6.1 |
| 4  | 2  | 3 | 2 |   |   |   |   |   |   |    |    |    | 1   | 2 | 3   | 1.2.1, 1.6.1, 2.5.3, 2.6.3<br>2.6.4, 3.5.1, 3.6.1 |

### COURSE CONTENT

#### UNIT I

**Light, Shading, and Color Modeling:** Pinhole Cameras, Light in Space, Light Surfaces, Important Special Cases, Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models, The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

**UNIT II**

**Linear Filters:** Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial and Frequency domain Transforms: DFT, DCT, DWT, Sampling and Aliasing, Representing Texture, Feature Extraction: Edges – Canny, LOG, Hough Transform, Corners – Orientation Histogram, SIFT, SURF, HOG, Scale-Space Analysis: Image Pyramids and Gabor filters.

**UNIT III**

**Geometry of Multiple Views:** Two Views, Stereopsis Reconstruction, Human Stereopsis, Binocular Fusion, Segmentation by Clustering: Segmentation, Grouping and Gestalt principles, Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-cut, Mean shift, Texture Segmentation; object detection: Viola Jones Algorithm.

**UNIT IV**

**Segmentation by Fitting a Model:** Fitting Lines, Fitting Curves, EM Algorithm, Tracking with Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations, Geometric Camera Calibration: Least-Squares Parameter Estimation.

**TEXTBOOKS**

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, 3rd Edition, Addison-Wesley, 2008.
2. David A. Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 1st Edition, PHI Learning (Indian Edition), 2009.

**REFERENCE BOOKS**

1. E. R. Davies, Computer and Machine Vision: Theory, Algorithms and Practicalities, 4th Edition, Elsevier (Academic Press), 2013.
2. Richard Szeliski, Computer Vision: Algorithms and Applications, 1st Edition, Springer-Verlag London Limited, 2011.
3. Richard Hartley, Andrew Zisserman, Multiple View Geometry in Computer Vision, 2nd Edition, Cambridge University Press, 2004.
4. K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Edition, Academic Press / Morgan Kaufmann, 1990.
5. Richard Szeliski, Computer Vision: Algorithms and Applications, 1st Edition, Springer, 2011.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. P. K. Biswas, IIT Kharagpur, NPTEL Course: Digital Image Processing, <https://www.nptel.ac.in/courses/20192020/EE579/>

- [//nptel.ac.in/courses/117105135](https://nptel.ac.in/courses/117105135) , Last Accessed On: 13/10/2025.
2. Prof. Jayanta Mukhopadhyay, IIT Kharagpur, NPTEL Course: Computer Vision, <https://nptel.ac.in/courses/106105216> , Last Accessed On: 12/09/2025.
  3. Prof. Vineeth N. Balasubramanian, IIT Hyderabad, NPTEL Course: Deep Learning for Computer Vision, <https://nptel.ac.in/courses/106106224> , Last Accessed On: 25/11/2025.

## 23AI&DS6404E

### AUTOMATA THEORY & COMPILER DESIGN

|                 |                                                     |                   |       |
|-----------------|-----------------------------------------------------|-------------------|-------|
| Course Category | PE II                                               | Credits           | 3     |
| Course Type     | Theory                                              | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS4303:Digital Logic and Computer organization | Continuous Eval   | 30    |
|                 |                                                     | Semester End Eval | 70    |
|                 |                                                     | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the theoretical foundations of computation through finite automata, regular languages, and their limitations.
2. Analyze the design of lexical Analyzers using formal methods and compiler construction tools.
3. Apply different Parsing Techniques to analyze the syntactic structure of the Programming statements.
4. Analyze Intermediate code generation strategies to generate the Machine code for program constructs.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                               |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                   |
| 1  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 2   |   | 2   | 1.2.1,1.6.1,1.7.1,2.5.2           |
| 2  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 2   |   | 4   | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 3.5.1 |
| 3  | 2  | 3 | 3 |   |   |   |   |   |   |    |    |    | 2   |   | 3   | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 3.5.1 |
| 4  |    | 2 | 3 |   |   |   |   |   |   |    |    |    | 2   |   | 4   | 2.5.2, 2.6.4, 2.7.1, 3.5.1        |

#### COURSE CONTENT

##### UNIT I

**Introduction to Finite Automata:** Structural Representations, Automata and Complexity, the Central Concepts of Automata Theory– Alphabets, Strings, Languages, Problems. Nondeterministic Finite Automata: Formal Definition, an application, Text Search, Finite Automata with Epsilon-Transitions.

**Deterministic Finite Automata:** Definition of DFA, How A DFA Processes Strings, The language of DFA, Conversion of NFA with  $\epsilon$ -transitions to NFA without  $\epsilon$ -transitions. Conversion of NFA to DFA.

**Regular Expressions:** Finite Automata and Regular Expressions, Applications of

Regular Expressions, Algebraic Laws for Regular Expressions, Conversion of Finite Automata to Regular Expressions. Pumping Lemma for Regular Languages: Statement of the pumping lemma, Applications of the Pumping Lemma.

## UNIT II

**Introduction:** Introduction to Compilers, The structure of a compiler.

**Lexical Analysis:** The Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, The Lexical- Analyzer Generator Lex.

**Context-Free Grammars:** Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Parse Trees, Ambiguity in Grammars and Languages.

## UNIT III

**Syntax Analysis:** Introduction, Context-Free Grammars, Writing a Grammar, Top- Down Parsing, Predictive Parsing, LL(1) Grammars, Bottom- Up Parsing.

**Introduction to LR Parsing:** Simple LR, More Powerful LR Parsers.

**Syntax-Directed Translation:** Syntax-Directed Definitions, Evaluation Orders for SDD's, Syntax Directed Translation Schemes, Implementing L-Attributed SDD's.

## UNIT IV

**Intermediate- Code Generation:** Variants of Syntax Trees, Three-Address Code.

**Run-Time Environments:** Stack Allocation of Space, Access to Nonlocal Data on the Stack, Heap Management.

**Code Generation:** Problems with code generation, Simple Code Generation, Code Generation from DAG's, Peephole Optimization.

## TEXTBOOKS

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, 3rd Edition, Pearson Education, 2006.
2. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools, 2nd Edition, Pearson, 2006.
3. K. L. P. Mishra, N. Chandrasekaran, Theory of Computer Science: Automata, Languages and Computation, 2nd Edition, PHI Learning, 2006.

## REFERENCE BOOKS

1. Kamala Krithivasan, Rama R, Introduction to Formal Languages, Automata Theory and Computation, 1st Edition, Pearson, 2009.
2. John C. Martin, Introduction to Languages and the Theory of Computation, 3rd Edition, Tata McGraw-Hill, 2003.
3. John R. Levine, Tony Mason, Doug Brown, Lex Yacc, 2nd Edition, O'Reilly, 1992.
4. Kenneth C. Loudon, Compiler Construction, 1st Edition, Course Technology, 1997.

## E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sourav Mukhopadhyay, Dept. of Mathematics, IIT Kharagpur, NPTEL



Course: Introduction to Automata, Languages and Computation, <https://archive.nptel.ac.in/courses/106/105/106105196/> , Last Accessed On: 26/04/2025.

2. Prof. Santanu Chatopadhyay, IIT Kharagpur, NPTEL Course: Compiler Design, <https://archive.nptel.ac.in/courses/106/105/106105190/> , Last Accessed On: 26/04/2025.

## 23AI&DS6405A

### QUANTUM COMPUTING

|                 |                                    |                   |       |
|-----------------|------------------------------------|-------------------|-------|
| Course Category | PE III                             | Credits           | 3     |
| Course Type     | Theory                             | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS3651:Python Programming lab | Continuous Eval   | 30    |
|                 |                                    | Semester End Eval | 70    |
|                 |                                    | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand the evolution and mathematical foundations of quantum computing.
2. Understand qubit implementation and key quantum mechanical principles.
3. Apply quantum gates and circuits to basic quantum algorithms.
4. Apply error correction and cryptographic techniques in quantum systems.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                        |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                            |
| 1  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 1   | 2 | 2   | 1.7.1,2.5.2,2.6.3          |
| 2  | 1  | 2 | 1 |   |   |   |   |   |   |    |    |    | 2   | 1 | 2   | 1.7.1, 2.5.2, 2.6.3, 3.5.4 |
| 3  | 1  | 2 | 2 |   | 1 |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.7.1, 2.5.2, 3.5.4,5.4.1  |
| 4  | 1  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.7.1, 2.5.2, 2.6.3,3.5.4  |

### COURSE CONTENT

#### UNIT I

**History of Quantum Computing:** Importance of Mathematics, Physics and Biology. Introduction to Quantum Computing: Bits Vs Qubits, Classical Vs Quantum logical operations.

**Background Mathematics:** Basics of Linear Algebra, Hilbert space, Probabilities and measurements.

#### UNIT II

**Background Physics & Biology:** Paul's exclusion Principle, Superposition, Entanglement and super-symmetry, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis. Basic concepts of Genomics and Proteomics (Central Dogma).

**Qubit:** Physical implementations of Qubit. Qubit as a quantum unit of information

**UNIT III**

**Quantum Circuits:** The Bloch sphere Quantum Circuits: single qubit gates, multiple qubit gates, designing the quantum circuits. Bell states.

**Quantum Algorithms:** Classical computation on quantum computers. Relationship between quantum and classical complexity classes, Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor's factorization algorithm, Grover's search algorithm.

**UNIT IV**

**Noise and error correction:** Graph states and codes, Quantum error correction, fault-tolerant computation.

**Quantum Information and Cryptography:** Comparison between classical and quantum information theory. Quantum Cryptography, Quantum teleportation.

**TEXTBOOKS**

1. Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, 1st Edition, Cambridge University Press, 2010.
2. N. S. Yanofsky, M. A. Mannucci, Quantum Computing for Computer Scientists, 1st Edition, Cambridge University Press, 2008.

**REFERENCE BOOKS**

1. G. Benenti, G. Casati, G. Strini, Principles of Quantum Computation and Information, Vol. I: Basic Concepts; Vol. II: Basic Tools and Special Topics, 1st Edition, World Scientific Publishing, 2004.
2. A. O. Pittenger, An Introduction to Quantum Computing Algorithms, 1st Edition, Birkhäuser, 1999.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. IBM Quantum, IBM Quantum Documentation, <https://quantum-computing.ibm.com/docs/> , Last Accessed On: 28/05/2025.
2. Microsoft, Quantum Development Kit Documentation, Microsoft Learn, <https://learn.microsoft.com/en-us/azure/quantum/> , Last Accessed On: 27/07/2025.
3. Quantum Algorithm Zoo, A Collection of Known Quantum Algorithms, National Institute of Standards and Technology (NIST), <https://quantumalgorithmzoo.org/> , Last Accessed On: 25/10/2025.

## 23AI&DS6405B

### NoSQL DATABASES

|                 |                                          |                   |       |
|-----------------|------------------------------------------|-------------------|-------|
| Course Category | PE III                                   | Credits           | 3     |
| Course Type     | Theory                                   | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS3304: Database Management Systems | Continuous Eval   | 30    |
|                 |                                          | Semester End Eval | 70    |
|                 |                                          | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand different types of NoSQL Databases.
2. Analyse the detailed architecture and performance of Document-oriented NoSQL databases.
3. Analyze the performance of Key-Value Pair NoSQL databases.
4. Analyse NoSQL development tools on different types of NoSQL Databases.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                                        |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|------------------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                            |
| 1  | 3  | 2 |   |   | 1 |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.7.1,2.5.1,2.5.2,2.7.1,3.5.1,5.5.2                        |
| 2  | 1  | 3 | 2 |   | 2 |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.2.1,1.7.1,2.5.2,2.6.4, 2.8.1 3.5.1, 3.6.1, 3.7.1,5.5.2   |
| 3  | 1  | 3 | 2 |   | 2 |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.2.1, 1.7.1 2.5.2, 2.6.4, 2.8.1 3.5.1, 3.6.1, 3.7.1,5.5.2 |
| 4  | 1  | 2 | 3 |   | 3 |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.7.1,2.5.1, 2.5.2 2.6.3, 2.7.1,3.5.1,5.5.2                |

### COURSE CONTENT

#### UNIT I

**Overview and Emergence of NoSQL Databases:** Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, The Value of Relational Databases, CAP Theorem, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL.

**UNIT II**

**MongoDB and Document Databases:** NoSQL Key/Value databases using MongoDB, Document Databases, CRUD Operations using MongoDB, Document oriented Database Features, Consistency, Transactions, Availability, Query Features, Scaling, Web Analytics or Real-Time Analytics, E-Commerce Applications, BASE Properties, Complex Transactions Spanning Different Operations.

**UNIT III**

**Column-Oriented NoSQL Databases:** Column-oriented NoSQL databases using Apache HBASE, Column-oriented NoSQL databases using Apache Cassandra Cassandra Queries (CQL), Architecture of HBASE, Column-Family Data Store Features, Consistency, Transactions, Availability

**UNIT IV**

**Key-Value and Graph NoSQL Databases:** NoSQL Key/Value databases using Riak, Key-Value Databases, Key-Value Store, Key-Value Store Features, Consistency, Transactions, Storing Session Information, Query by Data, Operations by Sets. Graph NoSQL databases using Neo4j, NoSQL database development tools and programming languages, Graph Databases, Graph Database Features, Consistency, Transactions, Availability.

**TEXTBOOKS**

1. M. Fowler, P. J. Sadalage, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, 1st Edition, Addison-Wesley, United Kingdom, 2013.
2. S. Bradshaw, K. Chodorow, E. Brazil, MongoDB: The Definitive Guide, 3rd Edition, O'Reilly Media, United States, 2020.

**REFERENCE BOOKS**

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, Introduction to Information Retrieval, 1st Edition, Cambridge University Press, 2008.
2. Stratos Idreos, Stefan Harizopoulos, Samuel Madden, Peter Boncz, Daniel Abadi, The Design and Implementation of Modern Column-Oriented Database Systems, 1st Edition, Morgan Claypool / Elsevier, Netherlands, 2013.
3. Gregory Harrison, Next Generation Databases: NoSQL and Big Data, 1st Edition, Apress, United States, 2015.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. IBM, What Are NoSQL Databases, <https://www.ibm.com/cloud/learn/nosql-databases> , Last Accessed On: 15/10/2025.
2. María del Pilar Angeles, Coursera Course: NoSQL Systems, <https://www.coursera.org/learn/nosql-databases> , Last Accessed On: 12/11/2025.
3. Saransh Sharma, Introduction to NoSQL, <https://www.geeksforgeeks.org/introduction-to-nosql/> , Last Accessed On: 15/11/2025.
4. Javatpoint, NoSQL Databases, <https://www.javatpoint.com/nosql-databases>

- es , Last Accessed On: 15/10/2025.
5. NPTEL, NOC: Fundamentals of Database Systems (Course code 106/104/135), Indian Institute of Technology Kanpur, <https://archive.nptel.ac.in/content/syllabus.pdf/106104135.pdf> , Last Accessed On: 20/11/2025.
  6. NPTEL, NOC: Big Data Computing (Course code 106/104/189), Indian Institute of Technology Patna, <https://nptel.ac.in/courses/106104189> , Last Accessed On: 15/10/2025.

## 23AI&DS6405C

### CLOUD COMPUTING

|                 |        |                   |       |
|-----------------|--------|-------------------|-------|
| Course Category | PE III | Credits           | 3     |
| Course Type     | Theory | L-T-P             | 3-0-0 |
| Prerequisites   | –      | Continuous Eval   | 30    |
|                 |        | Semester End Eval | 70    |
|                 |        | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand the fundamental cloud concepts, architecture, and service models.
2. Understand cloud-enabling technologies such as distributed computing, SOA.
3. Apply virtualization and container technologies to create scalable and secure cloud systems.
4. Apply advanced concepts in cloud computing to enable efficient automation and optimized cloud deployments.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                      |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                          |
| 1  | 3  | 2 |   |   | 3 |   |   |   |   |    |    | 1  |     | 2 | 2   | 1.7.1, 2.6.3, 5.4.1, 12.4.1              |
| 2  | 2  | 3 | 2 | 2 | 3 |   |   |   |   |    |    | 1  | 3   | 3 | 2   | 1.7.1,2.6.2, 3.5.1<br>5.4.1, 12.4.2      |
| 3  | 2  | 3 |   |   | 3 |   |   |   |   |    |    | 2  |     | 3 | 3   | 1.7.1,2.5.1,2.6.4<br>5.4.1,12.6.1        |
| 4  | 2  | 2 | 3 | 2 | 3 |   |   |   |   |    |    | 3  | 3   | 3 | 3   | 1.7.1,2.6.2,3.5.1<br>4.4.1,5.4.1,12.5. 1 |

### COURSE CONTENT

#### UNIT I

**Introduction to Cloud Computing Fundamentals:** Cloud computing at a glance, defining a cloud, cloud computing reference model (IaaS, PaaS, SaaS), cloud deployment models (public, private, hybrid), utility Oriented computing, cloud computing characteristics and benefits, cloud service providers (Amazon Web Services, Microsoft Azure, Google AppEngine).

#### UNIT II

**Cloud Enabling Technologies:** Parallel and distributed computing, elements of parallel computing, hardware architectures for parallel computing (SISD, SIMD,

MISD, MIMD), elements of distributed computing, Components Of A Distributed System, technologies for distributed computing, remote procedure calls (RPC), service-oriented architecture (SOA), Web services.

### UNIT III

**Virtualization, Containers and Cloud computing challenges:** Characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and cloud Computing, pros and cons of virtualization, technology examples (XEN, VMware), building blocks of containers, container platforms (LXC, Docker), container orchestration, Docker Swarm and Kubernetes, public cloud VM (e.g. Amazon EC2) and container (e.g. Amazon Elastic Container Service) offerings. Economics of the cloud, cloud interoperability and standards, scalability and fault tolerance, federated clouds.

### UNIT IV

**Advanced concepts in cloud computing:** Cloud computing security, fundamentals of computer security, cloud security architecture, security in cloud deployment models. Serverless computing, Function-as-a-Service, serverless computing architecture, public cloud (e.g. AWS Lambda) and open-source (e.g. OpenFaaS) serverless platforms, Internet of Things (IoT), applications, cloud-centric IoT and layers, edge and fog computing, DevOps, infrastructure-as-code, quantum cloud computing.

### TEXTBOOKS

1. Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, Shivananda Poojara, Satish N. Srirama, Mastering Cloud Computing, 2nd Edition, McGraw Hill, 2024.
2. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Distributed and Cloud Computing, 1st Edition, Elsevier, 2012.

### REFERENCE BOOKS

1. Dan C. Marinescu, Cloud Computing: Theory and Practice, 2nd Edition, Elsevier, 2018.
2. K. Chandrasekharan, Essentials of Cloud Computing, 1st Edition, CRC Press, 2014.

### E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Soumya Kanti Ghosh, NPTEL Course: Cloud Computing, [https://online.courses.nptel.ac.in/noc21\\_cs14/preview](https://online.courses.nptel.ac.in/noc21_cs14/preview) , Last Accessed On: 18/10/2025.
2. AWS, AWS Documentation, <https://docs.aws.amazon.com/> , Last Accessed On: 18/10/2025.
3. Google Cloud, Google Cloud Documentation, <https://cloud.google.com/docs> , Last Accessed On: 19/10/2025.
4. Stanford University, Technology Training: Introduction to Cloud Computing, <https://uit.stanford.edu/service/techtraining/class/introduction-clo>



**ud-computing** , Last Accessed On: 21/10/2025.

## 23AI&DS6405D

### SOCIAL MEDIA ANALYTICS

|                 |        |                   |       |
|-----------------|--------|-------------------|-------|
| Course Category | PE III | Credits           | 3     |
| Course Type     | Theory | L-T-P             | 3-0-0 |
| Prerequisites   | –      | Continuous Eval   | 30    |
|                 |        | Semester End Eval | 70    |
|                 |        | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the evolution of the World Wide Web and the emergence of social media.
2. Apply the foundations, methodologies, and tools of social media analytics.
3. Analyse social media text, action, and hyperlink analytics using real-world social media data.
4. Analyse social media data to identify patterns, trends, and insights that support business decision-making and research activities.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                     |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                         |
| 1  | 3  | 2 |   |   |   |   |   |   |   |    |    |    | 2   |   | 2   | 1.6.1,2.7.4             |
| 2  | 3  | 3 | 2 |   |   |   |   |   |   |    |    |    | 2   | 1 | 3   | 1.6.1,2.7.4,3.4.1       |
| 3  | 2  | 3 | 3 | 2 |   |   |   |   |   |    |    |    | 3   | 2 | 4   | 1.6.1,2.7.4,3.4.1,4.3.1 |
| 4  |    | 2 | 3 | 3 |   |   |   |   |   |    |    |    | 3   | 3 | 4   | 2.7.4,3.4.1,4.3.1       |

#### COURSE CONTENT

##### UNIT I

**Introduction to the World Wide Web-Evolution of the Web:** Web 1.0, Web 2.0, Web 3.0-Understanding Social Media-Core Characteristics of Social Media-Types of Social Media-Social Networking Sites-Using Facebook for Business Purposes-Content Communities.

##### UNIT II

**Overview and Purpose of Social Media Analytics-Comparison:** Social Media Analytics vs. Traditional Business Analytics-Seven Layers of Social Media Analytics-Types of Social Media Analytics-Social Media Analytics Cycle-Challenges in Social Media Analytics-Social Media Analytics Tools.

**Case Study:** The Underground Campaign That Scored Big

**UNIT III**

**Social Media Text Analytics:** Types of Social Media Text-Purpose of Text Analytics-Steps in Text Analytics-Social Media Text Analysis Tools. Case Study: Tapping Into Online Customer Opinions.

**Social Media Actions Analytics:** Introduction to Actions Analytics-Common Social Media Actions-Actions Analytics Tools.

**Case Study:** Cover-More Group.

**UNIT IV**

**Social Media Hyperlink Analytics:** Types of Hyperlinks-Concept and Importance of Hyperlink Analytics-Types of Hyperlink Analytics-Hyperlink Analytics Tools-Integrating Text, Action, and Hyperlink Analytics for Business Intelligence- Emerging Trends and Future Directions in Social Media Analytics.

**TEXTBOOKS**

1. Gohar F. Khan, Seven Layers of Social Media Analytics: Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, and Location Data, 1st Edition, Springer, 2023.

**REFERENCE BOOKS**

1. L. Hemann, K. Burbary, Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World, 1st Edition, Que Publishing, Indianapolis, IN, USA, 2013.
2. D. Zeng, H. Chen, R. Lusch, Social Media Analytics: Understanding the Opportunities and Challenges, Communications of the ACM, Vol. 54, No. 11, pp. 25–28, 2010.
3. P. Kotler, H. Kartajaya, I. Setiawan, Marketing 5.0: Technology for Humanity, 1st Edition, Wiley, Hoboken, NJ, USA, 2021.
4. Y. Punie, R. Vuorikari, Editors, Social Media and Learning Analytics: European Perspectives, 1st Edition, Springer, Cham, Switzerland, 2019.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. C. Záchlod, Analytics of Social Media Data – State of Characteristics, ScienceDirect, 2022, <https://www.sciencedirect.com/science/article/pii/S0148296322001321> , Last Accessed On: 02/09/2025.
2. A. Mohamed, Social Media Text Analytics: Decoding the Digital Dialogue, AIM Technologies, 2024, <https://www.aimtechnologies.co/2023/12/05/socialmedia-text-analytics-decoding-the-digital-dialogue/> , Last Accessed On: 18/08/2025.

**23AI&DS6351****NATURAL LANGUAGE PROCESSING & DEEP LEARNING LAB**

|                 |                                    |                   |       |
|-----------------|------------------------------------|-------------------|-------|
| Course Category | PC LAB-1                           | Credits           | 1.5   |
| Course Type     | Laboratory                         | L-T-P             | 0-0-3 |
| Prerequisites   | 23AI&DS3651:Python Programming lab | Continuous Eval   | 30    |
|                 |                                    | Semester End Eval | 70    |
|                 |                                    | Total Marks       | 100   |

**COURSE OUTCOMES**

1. Analyze natural language processing techniques—such as word embeddings, POS tagging, morphological analysis, n-grams, and spell correction—using Python and NLTK libraries.
2. Apply different NLP techniques using NLTK package.
3. Apply pre-trained deep learning models such as LeNet and AlexNet to improve accuracy and efficiency in image classification tasks.
4. Analyze the performance of various neural network models (MLP, CNN, RNN, LSTM) using real-world datasets for binary and multiclass classification problems.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                             |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                 |
| 1  | 3  | 3 | 3 | 2 |   |   |   |   |   |    |    |    | 2   | 2 | 4   | 1.7.1,2.6.3,2.6.4<br>2.8.3,2.8.4,3.7.1<br>4.5.1 |
| 2  | 3  | 2 | 3 | 2 |   |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.7.1,2.6.3,2.6.4<br>2.8.3,2.8.4,3.7.1<br>4.5.1 |
| 3  | 3  | 3 | 3 | 3 |   |   |   |   |   |    |    |    | 3   | 3 | 3   | 1.7.1,2.6.3,2.6.4<br>2.8.3,2.8.4,3.7.1<br>4.5.1 |
| 4  | 3  | 3 | 3 | 3 |   |   |   |   |   |    |    |    | 3   | 3 | 4   | 1.7.1,2.6.3,2.6.4<br>2.8.3,2.8.4,3.7.1<br>4.5.1 |

## **COURSE CONTENT**

**Task 1:** Create Sample list at least 10 words POS tagging and find the POS for any given word.

**Task 2:** Write a Python program to

- i). Perform Morphological Analysis using NLTK library
- ii). Generate n-grams using NLTK N-Grams library
- iii). Implement N-Grams Smoothing

**Task 3:** Using NLTK package to convert audio file to text and text file to audio files.

**Task 4:** Write a program to perform Auto-Correction of spellings for any text.

**Task 5:** Implement rule-based and statistical POS tagging on a larger text corpus and compare the tagging accuracy.

**Task 6:** Build a simple grammar-based language model and a statistical n-gram language model, then compare sentence probability scores.

**Task 7:** Implement Multilayer Perceptron algorithm for MNIST Handwritten Digit Classification.

**Task 8:** Design Neural Network for following problems

- i). Movie reviews classification (Binary Classification) using IMDB dataset.
- ii). News Wires classification (Multiclass Classification) using Reuters dataset.

**Task 9:** Implement a Recurrent Neural Network (RNN) and LSTM for IMDB movie review classification problem.

**Task 10:** Build a Convolution Neural Network for simple image (dogs and Cats) Classification.

**Task 11:** Use a Pre-trained Convolution Neural Network LeNet, AlexNet for image classification.

**Task 12:** Implement One Hot Encoding and Word Embeddings on any real world dataset.

## **TEXTBOOKS**

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 1st Edition, MIT Press, 2016.

## **REFERENCE BOOKS**

1. Daniel Jurafsky, James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2nd Edition, Pearson, 2014.
2. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, 1st Edition, O'Reilly Media, 2009.

## **E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Prof. Sudharshan Iyengar, Department of Computer Science and Engineering, IIT Ropar, and Prof. Mitesh M. Khapra, Department of Computer Science and

- Engineering, IIT Madras, NPTEL Course: Natural Language Processing, <https://nptel.ac.in/courses/106106184> , Last Accessed On: 27/10/2025.
2. Prof. Prabir Kumar Biswas, Department of Electronics and Electrical Engineering, IIT Kharagpur, NPTEL Course, [https://onlinecourses.nptel.ac.in/noc20\\_cs62/preview](https://onlinecourses.nptel.ac.in/noc20_cs62/preview) , Last Accessed On: 01/11/2025.

## 23AI&DS6352

### BIG DATA ANALYTICS LAB

|                 |                                                         |                   |       |
|-----------------|---------------------------------------------------------|-------------------|-------|
| Course Category | Program Core                                            | Credits           | 1.5   |
| Course Type     | Laboratory                                              | L-T-P             | 0-0-3 |
| Prerequisites   | 23AI&DS:Object Oriented<br>Programming Through Java Lab | Continuous Eval   | 30    |
|                 |                                                         | Semester End Eval | 70    |
|                 |                                                         | Total Marks       | 100   |

### COURSE OUTCOMES

1. Apply Hadoop to configure and manage distributed file systems using HDFS.
2. Analyze and optimize MapReduce programs for large-scale data analysis.
3. Apply Hadoop ecosystem for analyzing data.
4. Analyze Pig and Hive for efficient data querying management.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                        |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                            |
| 1  | 3  | 2 |   | 1 |   |   |   |   |   |    |    |    | 3   | 2 | 3   | 1.7.1, 2.5.1, 2.5.2, 4.4.2 |
| 2  | 1  |   | 2 |   | 3 |   |   |   |   |    |    |    | 3   | 3 | 4   | 1.7.1, 3.6.1, 3.8.2, 5.5.2 |
| 3  |    | 1 |   | 2 | 3 |   |   |   |   |    |    |    | 3   | 3 | 3   | 2.6.3, 2.8.1, 4.6.1, 5.4.1 |
| 4  |    | 1 |   | 2 | 3 |   |   |   |   |    |    |    | 3   | 3 | 4   | 2.7.1, 4.6.2, 5.5.1, 5.6.1 |

### COURSE CONTENT

**Task 1:** Hadoop Installation and shell commands

**Task 2:** File management operations in Hadoop.

**Task 3:** Data import and export operations between HDFS and local file system.

**Task 4:** Word Count application: Implementation of Word Count Program using MapReduce Paradigm.

**Task 5:** Weather Data Analysis :Implementation of Map reduce algorithm for analyzing hot and cold days.

**Task 6:** Map reduce Application: Implement a MapReduce program to identify “common friends” among all pairs of users.

**Task 7:** Develop Pig scripts for data processing.

**Task 8:** Apache Spark transformations on RDD- Resilient Distributed Dataset.

**Task 9:** Database manipulation using Hive :To create, alter, drop databases and views.

**Task 10:** Functions and indexes in Hive: To create functions and indexes in Hive.

**TEXTBOOKS**

1. Tom White, Hadoop: The Definitive Guide, 1st Edition, O'Reilly Media, Inc., 2015.

**REFERENCE BOOKS**

1. Chuck Lam, Hadoop in Action, 1st Edition, Manning Publications, 2010.
2. Dirk de Roos, Paul C. Zikopoulos, Roman B. Melnyk, Bruce Brown, Rafael Coss, Hadoop for Dummies, 1st Edition, Wiley, 2014.
3. Alex Holmes, Hadoop in Practice, 2nd Edition, Manning Publications, 2015.
4. A. Krishna Mohan, E. Laxmi Lydia, Big Data Analytics, 1st Edition, CRC Press, 2023.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Prof. A Ramesh, IIT Roorkee, NPTEL Course: Data Analytics with Python, <https://nptel.ac.in/courses/106107220> , Last Accessed On: 02/09/2025.
2. Prof. Nandan Sudarsanam and Prof. Balaraman Ravindran, IIT Madras, NPTEL Course: Introduction to Data Analytics, <https://nptel.ac.in/courses/110106072> , Last Accessed On: 12/08/2025.
3. rof. Dr. Mohit Bhatnagar, O.P. Jindal Global University, Coursera Course: Big Data Analytics, <https://www.coursera.org/learn/big-data-analytics-1> , Last Accessed On: 20/07/2025.
4. Gerald Balekaki and Ming-Long Lam, Illinois Tech, Coursera Specialization: Data Analytics and Big Data, <https://www.coursera.org/specializations/data-analytics-and-big-data> , Last Accessed On: 20/07/2025.



## 23TP6107

### QUANTITATIVE APTITUDE

|                 |                   |                   |       |
|-----------------|-------------------|-------------------|-------|
| Course Category | SS - 4            | Credits           | 1     |
| Course Type     | Learning by Doing | L-T-P             | 0-0-2 |
| Prerequisites   | –                 | Continuous Eval   | 100   |
|                 |                   | Semester End Eval | –     |
|                 |                   | Total Marks       | 100   |

### COURSE OUTCOMES

1. Solve various Basic Mathematics problems by following different methods
2. Follow strategies in minimizing time consumption in problem solving Apply short-cut methods to solve problems
3. Confidently solve any mathematical problems and utilize these mathematical skills both in their professional as well as personal life.
4. Analyze, summarize and present information in quantitative forms including table, graphs and formulas

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 2  |   |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 2  |    | 2 |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 3  | 2  |   |   |   |   |   |   |   |   |    |    |    |     |   |     |     |
| 4  |    |   |   | 2 |   |   |   |   |   |    |    |    |     |   |     |     |

### COURSE CONTENT

#### UNIT I

##### **Numerical ability I:**

Number system, HCF & LCM, Average, Ratio & Proportion

##### **Numerical ability II:**

Problems on ages, Partnership, Percentages, Profit & Loss, Allegation

#### UNIT II

##### **Arithmetical ability I:**

Time & Work, Pipes & Cistern, Chain Rule

##### **Arithmetical ability II:**

Time & Distance, Problems on Trains, Boats & Steams

### **UNIT III**

#### ***Arithmetical ability III:***

Simple interest and compound interest, Calendar and Clock

#### ***Logical ability:***

Permutations and Combination, and Probability, Cubes

### **UNIT IV**

#### ***Mensuration:***

Areas, Volumes

#### ***Data interpretation:***

Tabulation, Bar graphs, Pie charts, line graphs

### **TEXTBOOKS**

1. R. S. Aggarwal, Quantitative Aptitude, Revised Edition, S. Chand Publications, 2017, ISBN: 8121924987.

# SEMESTER VII

## 23AI&DS7301 GENERATIVE AI

|                 |                                            |                   |       |
|-----------------|--------------------------------------------|-------------------|-------|
| Course Category | Program Core                               | Credits           | 3     |
| Course Type     | Theory                                     | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS5302:Principles of Machine Learning | Continuous Eval   | 30    |
|                 |                                            | Semester End Eval | 70    |
|                 |                                            | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand the concepts, models, and ethical considerations of Generative AI for developing responsible AI-based applications.
2. Apply generative language models and prompt engineering techniques to design effective AI-driven text generation solutions.
3. Apply GAN-based image generation models and multi modal architectures for AI-driven image and text processing applications.
4. Apply transformer-based models, open-source LLMs, and fine-tuning techniques to develop generative AI applications for music and text generation.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                        |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                            |
| 1  | 3  | 2 |   |   |   |   |   |   |   |    |    |    | 2   | 1 | 2   | 1.2.1, 1.3.1, 1.7.1 2.1.1                  |
| 2  | 3  | 2 |   |   |   |   |   |   |   |    |    |    | 2   | 1 | 3   | 1.2.1, 1.3.1, 1.7.1, 2.1.1                 |
| 3  | 3  | 3 | 2 |   |   |   |   |   |   |    |    |    | 3   | 2 | 3   | 1.2.1, 2.1.1, 2.2.1<br>3.1.1, 3.2.1        |
| 4  | 3  | 3 | 3 |   |   |   |   |   |   |    |    |    | 3   | 3 | 3   | 1.2.1, 1.7.1, 2.1.1<br>2.2.1, 2.7.2, 3.7.1 |

### COURSE CONTENT

#### UNIT I

**Introduction To Gen AI:** Generative AI, Generative Versus Discriminative Modelling, Generative Modelling vs AI Agents vs Agentic AI, The Generative Modelling Framework, Generative Model Taxonomy, Explicit Density Models, Implicit Density Models, GenAI Types, GAN, Diffusion model, Transformers, Uses of Generative AI, Importance of Generative Models in AI.

**Responsible AI:** Key Principles of Responsible AI, Responsible AI to Benefit Society, Case Studies, Real world Examples of responsible AI Implementation, Ethical AI vs Responsible AI.

## UNIT II

**Generative Models for Text:** Understanding tokens and Embeddings, Word Embeddings, Word2Vec, GloVe, Understanding transformers, Encoder, Decoder, BERT and GPT models Significance of Large Language Models, Working of Large Language Models, Importance of Pre-trained Language Models, Evaluation of Generative Language Models, Risks and Limitations of Large Language Models.

**Prompt Engineering:** Defining Prompt Engineering, Iterative Journey to Great Prompts, Revising prompts using Reinforcement Learning from Human Feedback (RLHF), Prompts Engineering of the Future, Challenges in Crafting Effective Prompts.

## UNIT III

**Generation of Images:** Autoencoders, The Autoencoder Architecture, The Encoder, The Decoder, Joining the encoder to the Decoder, Reconstructing Images, Visualizing the Latent Space, Generating new Images, Variational Autoencoders.

**Generative Adversarial Networks:** Deep Convolutional GAN, The Discriminator, The Generator, Training the DCGAN, Analysis of DCGAN, Conditional GAN, Architecture.

**MultiModal Models:** DALL.E 2 Architecture, The text Encoder, CLIP, The Prior, The Decoder.

## UNIT IV

**Generation of Music:** Introduction, Transformers for music generation, Tokenization, Architecture, Analysis.

**Open Source Models and Programming:** Closed Source Models vs Open Source Models, Hugging Face, A hub of Open-Source AI Models, Open Source Generative AI models and their impact, Llama, Falcon, Mistral, Zephyr, Fine Tune Models Vs Pre-Trained Models, Fine Tuning of Llama 2.

**Programming LLMs:** Introduction to LangChain, Components of LangChain, Schema, Text, Chat Messages, Models, BERT, GPT-3, LaMDA GPT-4, Prompts, Indexes, Document Loaders, Text Splitters, Vector Stores, Retrievers, Memory Applications of LangChain Retrieval Augmented Generation, Workflow.

## TEXTBOOKS

1. D. Foster, Generative Deep Learning, O'Reilly Books, 2024.
2. A. Rehmani, Generative AI for Everyone, BlueRose One, 2024.

## REFERENCE BOOKS

1. Denis Rothman, "Transformers for Natural Language Processing and Computer Vision", Third Edition, Packt Books, 2024

## E-RESOURCES AND OTHER DIGITAL MATERIALS

1. NPTEL, Deep Learning for Computer Vision, [Online]. Available: <https://onlinecourses.nptel.ac.in/noc25&cs93/preview> , Last accessed on: 10-04-2026.  
NPTEL, Programming with Generative AI, [Online]. Available: <https://onlinecourses.nptel.ac.in/noc25&cs137/preview> , Last accessed on: 5-02-2026.

## **REFERENCE BOOKS**

1. D. Rothman, Transformers for Natural Language Processing and Computer Vision, 3rd ed., Packt Books, 2024.

## **E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. NPTEL, Deep Learning for Computer Vision, [Online]. Available: <https://onlinecourses.nptel.ac.in/noc25&cs93/preview> , Last accessed on: 10-04-2026.
2. NPTEL, Programming with Generative AI, [Online]. Available: <https://onlinecourses.nptel.ac.in/noc25&cs137/preview> , Last accessed on: 08-03-2026.

## HUMAN RESOURCES & PROJECT MANAGEMENT

|                 |        |                   |       |
|-----------------|--------|-------------------|-------|
| Course Category | MC     | Credits           | 2     |
| Course Type     | Theory | L-T-P             | 2-0-0 |
| Prerequisites   | –      | Continuous Eval   | 30    |
|                 |        | Semester End Eval | 70    |
|                 |        | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand fundamental concepts of Human Resource Management including planning, recruitment, selection, training and performance appraisal.
2. Analyze HRD practices such as training methods, career development, group dynamics and HR accounting.
3. Apply project management principles including project life cycle, scheduling and resource allocation.
4. Analyze different project types and implement appropriate management strategies including leadership and conflict resolution.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |     |
| 1  | 3  | 2 |   |   |   |   |   |   |   |    | 1  |    | 1   |   | 2   |     |
| 2  | 2  | 3 | 2 | 2 |   |   |   |   | 1 | 2  | 2  |    |     | 1 | 4   |     |
| 3  | 3  | 2 | 3 | 2 |   |   |   |   | 1 | 2  | 3  |    | 1   |   | 3   |     |
| 4  | 3  | 3 | 4 | 3 |   |   |   |   | 1 | 3  | 2  |    |     | 1 | 4   |     |

### COURSE CONTENT

#### UNIT I

**Human Resource Management:** Nature, Scope and Concept of HRM, Functions of HRM, Role of HR Manager, Emerging Trends in HRM (E-HRM), HR Audit Models, Ethical Aspects of HRM.

**HR Planning and Development:** Demand and Supply Forecasting, Job Design, Recruitment, Sources of Recruitment, Selection Procedure, HRD Models, Training and Development, Methods of Training, Career Development and Counselling, Group Dynamics, HR Accounting, Performance Appraisal and Methods.

**UNIT II**

**Basics of Project Management:** Concept, Project Environment, Types of Projects, Project Life Cycle, Project Proposals, Project Networks (DPR), Project Appraisal and Selection.

**Project Planning and Monitoring:** Resource Management, Monitoring Project Progress, 80-20 Rule, Production Technology, Communication Matrix.

**UNIT III**

**Project Types and Strategies:** Infrastructure Projects, Industrial Projects, Service Projects, Social Projects and their Management Challenges.

**Scheduling and Resource Allocation:** Project Scheduling Techniques, Resource Allocation Strategies.

**UNIT IV**

**Project Implementation and Control:** Forms of Project Organization, Prerequisites for Successful Implementation, Project Planning and Control.

**Project Evaluation and Leadership:** Human Aspects of Project Management, Conflict Resolution, Leadership in Projects, Project Review, Performance Evaluation, Abandonment Analysis.

**TEXTBOOKS**

1. R. L. Mathis, J. H. Jackson, M. R. Tripathy, Human Resource Management, Cengage Learning, 2016.
2. S. Pande, S. Basak, Human Resource Management: Text and Cases, 2nd Edition, Vikas Publishing, 2016.
3. S. R. Clegg, T. Skyttermoen, A. L. Vaagaasar, Project Management, 1st Edition, Sage Publications, 2021.
4. K. Nagarajan, Project Management, 8th Edition, New Age International Publishers, 2017.

**REFERENCE BOOKS**

1. P. Subba Rao, Personnel and Human Resource Management: Text and Cases, Himalaya Publications, 2013.
2. K. Aswathappa, Human Resource and Personnel Management, Tata McGraw Hill, 2013.
3. P. Chandra, Projects: Planning, Analysis, Selection, Financing, Implementation and Review, Tata McGraw Hill, 1998.
4. V. Desai, Project Management, 4th Edition, Himalaya Publications, 2018.
5. L. Balakrishnan, Gowri, Project Management, Himalaya Publishing House, 2022.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. A. Malik, *Principles of Human Resource Management*, NPTEL, IIT Kharagpur, 2021. Available at: [https://onlinecourses.nptel.ac.in/noc21\\_mg21/previ](https://onlinecourses.nptel.ac.in/noc21_mg21/previ)



- ew, Last Accessed on: 05/05/2026.
2. A. Ramesh, *Project Management*, NPTEL, IIT Roorkee, 2026. Available at: <http://nptel.ac.in/courses/110107430>, Last Accessed on: 05/05/2026.
  3. G. Parente, *Strategic HRM: Talent, Performance and Compensation Design*, Coursera, 2026. Available at: <https://www.coursera.org/learn/strategic-hrm-talent-performance-compensation-design>, Last Accessed on: 05/05/2026.

## 23AI&DS7403A

### SOFTWARE ARCHITECTURE AND DESIGN PATTERN

|                 |                                   |                   |       |
|-----------------|-----------------------------------|-------------------|-------|
| Course Category | PE IV                             | Credits           | 3     |
| Course Type     | Theory                            | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS5404A:Software Engineering | Continuous Eval   | 30    |
|                 |                                   | Semester End Eval | 70    |
|                 |                                   | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the basic concepts to identify state behavior of real world objects
2. Apply Object Oriented Analysis and Design concepts to solve complex problems
3. Apply various UML models using the appropriate notation for specific problem context
4. Analyze models to Show the importance of systems analysis and design in solving complex problems using case studies

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                    |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                        |
| 1  | 3  |   |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.7.1                                  |
| 2  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.7.1,2.6.3,2.6.4<br>2.8.3,2.8.4,3.7.1 |
| 3  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 3   | 1.7.1,2.5.2,2.6.3<br>2.6.4,2.8.4,3.7.1 |
| 4  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 4   | 1.7.1,2.5.2,2.6.3<br>2.6.4,2.8.4,3.7.1 |

#### COURSE CONTENT

##### UNIT I

**Introduction:** Object-oriented Paradigm, Object Oriented Approach, Object oriented Software development, Key concepts of object oriented design other related concepts, Modular design and encapsulation, Cohesion and Coupling, Modifiability and Testability, Code Security, benefits of paradigm, Dealing with drawbacks of the paradigm, Reduced Performance, Complexity of the System, Learning the Object Oriented Paradigm.

**Basics of Object Oriented Programming:** Implementing Classes, Constructors, Printing an object, Sharing Data across all objects, Creating and Working with related Classes, Defining and working with collections, Creating a collection class,

Implementation of Student Linked List, Interfaces, Improve Reuse with an interface, Array implementation of Lists.

## UNIT II

**Modelling Object Oriented Systems:**Diagrams to describe an Object Oriented System, Building a User Interface Model, Requirement for an ATM system, Detailed Use Case for the ATM, Building a logical Model, A logical Model for ATM System, A Logical Model for a College Registration System.

**Analysing a System:** Gathering the requirements, Library Case Study, Building User Interaction Model, Use Case Analysis, Detailed Use Case for the Library System, Defining conceptual classes and Relationship, Identifying the relationships between the Classes, Using the knowledge of the domain.

## UNIT III

**Interactive systems and the MVC architecture:** Introduction The MVC architectural pattern, analyzing a simple drawing program, Specifying the Requirements, Defining the User Interface, Detailed use cases for drawing operations, Drawing the shapes.

**Designing the drawing program:**Shape representation, Interaction between model view and controller, Interface dependent, controller and View, Design to support undo and redo, system, Grouping, Ungrouping and shape collection, Selecting, deleting and moving, Controller Structure, Sequence Diagrams for Shape manipulation. Implementation, Starting a program, drawing a line, Selecting shapes, Grouping and Moving.

## UNIT IV

**Introduction:** Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog.

**Design Pattern Catalog:** Creational Patterns, Abstract Factory, Builder, Factory Method, Prototype, Singleton, Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy. Behavior Patterns, Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State.

## TEXTBOOKS

1. B. Dathan and S. Ramnath, Object-Oriented Analysis, Design and Implementation: An Integrated Approach, 3rd ed., Universities Press, 2024. [Unit I, II, III]
2. E. Gamma, R. Helm, R. Johnson, and J. Vlissides, Design Patterns, Reprint ed., Pearson Education India, Noida, India, 2023. [Unit IV]

## REFERENCE BOOKS

1. Frank Bachmann, Regine Meunier, Hans Rohnert "Pattern Oriented Software Architecture" Volume 1, 1996.
2. William J Brown et al., "Anti Patterns: Refactoring Software, Architectures and Projects in Crisis", John Wiley, 1998

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. S. Iyer, P. Prasad, and T. G. Lakshmi, Software Conceptual Design, NPTEL, [Online]. Available: <https://onlinecourses.nptel.ac.in/noc22&cs39/preview> , Last accessed on: 19/04/2026.
2. University of Alberta, Software Design and Architecture Specialization, [Online]. Available: <https://www.coursera.org/specializations/software-design-architecture> , Last accessed on: 19/04/2026.
3. Refactoring Guru, Design Patterns Tutorial, [Online]. Available: <https://refactoring.guru/design-patterns> , Last accessed on: 19/04/2026.

## 23AI&DS7403B

### BLOCK CHAIN TECHNOLOGY

|                 |                               |                   |       |
|-----------------|-------------------------------|-------------------|-------|
| Course Category | PE-IV                         | Credits           | 3     |
| Course Type     | Theory                        | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS6303:Computer Networks | Continuous Eval   | 30    |
|                 |                               | Semester End Eval | 70    |
|                 |                               | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand blockchain fundamentals and basic cryptographic concepts.
2. Apply blockchain mechanisms to analyze Bitcoin systems.
3. Apply consensus algorithms and smart contracts in blockchain platforms.
4. Analyze blockchain frameworks, applications, and limitations.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                        |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                            |
| 1  | 2  | 2 | 1 |   |   |   |   |   |   |    |    |    | 3   | 1 | 2   | 1.2.1, 1.2.2, 2.8.1, 3.8.1 |
| 2  | 2  | 2 | 1 |   |   |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.2.1, 1.2.2, 2.8.1, 3.8.1 |
| 3  | 2  | 2 | 2 |   |   |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.2.1, 1.2.2, 2.6.3, 3.8.1 |
| 4  | 2  | 2 | 1 |   |   |   |   |   |   |    |    |    | 3   | 2 | 4   | 1.2.1, 1.2.2, 2.6.3, 3.8.1 |

#### COURSE CONTENT

##### UNIT I

**Introduction to blockchain:** Introduction, history of Bitcoin and Origins of Blockchain, Fundamentals of Blockchain and key components, Permission and Permission-less platforms, Introduction to Cryptography, SHA256 and ECDSA, Hashing and Encryption, Symmetric/ Asymmetric keys, Private and Public Keys.

##### UNIT II

**Technologies Borrowed in Blockchain:** Technologies Borrowed in Blockchain –hash pointers- - Digital cash etc.- Bitcoin blockchain - Wallet – Blocks Merkle Tree - hardness of mining - Transaction verifiability - Anonymity - forks - Double spending - Mathematical analysis of properties of Bitcoin - Bitcoin- the challenges and solutions.

### UNIT III

**Consensus Mechanisms:** Consensus Algorithms: Proof of Work (PoW) as random oracle - Formal treatment of consistency- Liveness and Fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS), Byzantine Models of fault tolerance.

**ETHEREUM:** Ethereum -Ethereum Virtual Machine (EVM) -Wallets for Ethereum - Solidity - Smart Contracts, - The Turing Completeness of Smart Contract Languages and verification challenges- Using smart contracts to enforce legal contracts.

### UNIT IV

**Hyperledger Fabric:** Hyperledger fabric- the plug and play platform and mechanisms in permissioned blockchain - Beyond Cryptocurrency – applications of blockchain in cyber security- integrity of information- E-Governance and other contract enforcement mechanisms Limitations of blockchain as a technology and myths vs reality of blockchain technology.

### TEXTBOOKS

1. C. Subramanian, A. A. George, K. A. Abhilash, and M. Karthikeyan, Blockchain Technology, University Press, 2020.
2. I. Bashir, Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained, 2nd ed., Packt Publishing, 2018.

### REFERENCE BOOKS

1. S. Shukla, M. Dhawan, S. Sharma, and S. Venkatesan, Blockchain Technology: Cryptocurrency and Applications, Oxford University Press, 2019.
2. W. Stallings, Cryptography and Network Security: Principles and Practice, 8th ed., Pearson, 2017.

### E-RESOURCES AND OTHER DIGITAL MATERIALS

1. IIT Kharagpur, S. Chakraborty, and S. Sural, NPTEL Course on Blockchain Technology, [Online]. Available: <https://onlinecourses.nptel.ac.in/noc26&cs34/preview> , Last accessed on: 24/04/2026.
2. IIT Kanpur and S. Shukla, NPTEL: Introduction to Blockchain Technology and Applications, [Online]. Available: <https://onlinecourses.nptel.ac.in/noc20&cs01/preview> , Last accessed on: 24/04/2026.
3. B. Ramamurthy, Blockchain Basics, [Online]. Available: <https://www.coursera.org/learn/blockchain-basics> , Last accessed on: 24/04/2026.
4. MIT and G. Gensler, Blockchain and Money, [Online]. Available: <https://ocw.mit.edu/courses/15-s12-blockchain-and-money-fall-2018/> , Last accessed on: 24/04/2026.

## 23AI&DS7403C

### DevOps

|                 |                               |                         |       |
|-----------------|-------------------------------|-------------------------|-------|
| Course Category | PE-IV                         | Credits                 | 3     |
| Course Type     | Theory                        | L-T-P                   | 3-0-0 |
| Prerequisites   | 23AI&DS6405C: Cloud Computing | Continuous Evaluation   | 30    |
|                 |                               | Semester End Evaluation | 70    |
|                 |                               | Total Marks             | 100   |

### COURSE OUTCOMES

1. Understand the basics of Devops and its history.
2. Understand the concepts of container and its lifecycle, dockerfile, and multi containers orchestration.
3. Apply Kubernetes components and resources to efficiently deploy, manage, and scale containerized applications.
4. Apply robust monitoring and logging solutions for containerized applications and manage Kubernetes resources.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                 |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                     |
| 1  | 1  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 2   | 1.6.1, 2.7.1, 3.5.3 |
| 2  |    | 1 | 3 |   | 2 |   |   |   |   |    |    |    | 1   | 2 | 2   | 2.5.2, 3.8.2, 5.5.2 |
| 3  |    | 1 | 2 |   | 3 |   |   |   |   |    |    |    | 1   | 3 | 3   | 2.5.2, 3.6.2, 5.6.2 |
| 4  |    | 1 | 2 |   | 3 |   |   |   |   |    |    |    | 1   | 3 | 3   | 2.5.2, 3.8.3, 5.4.2 |

### COURSE CONTENT

#### UNIT I

**DevOps and History:** The Devops Equation, Devops as Folk Model, The Old View and the New View, Devops Compact, Developer as Operator, Advent of Software Engineering, Advent of Proprietary Software and Standardization, Age of the Network, Beginnings of a Global Community, Age of Applications and the Web, Growth of Software Development Methodologies, Open Source Software, Proprietary Services, Agile Infrastructure, Beginning of DevOpsdays, Current State of DevOps.

**DevOps Misconceptions and Anti-Patterns:** Common DevOps Misconceptions, DevOps Anti-Patterns, Four Pillars of Effective DevOps.

## UNIT II

**Container and Container Life Cycle:** Resource Isolation, Linux Container Concept, Containerized Delivery, Installing Docker for Ubuntu, CentOS, macOS, Container life cycle – Docker Basics, Layer, Image, Container, and Volume, Distributing Images, Connect Containers.

**Dockerfile and Multi-Containers Orchestration:** Writing your first Dockerfile, Dockerfile Syntax, Organizing a Dockerfile, Piling up Containers, Docker Compose Overview, Composing Containers.

## UNIT III

**Kubernetes Components:** Master components – API Server (kube-apiserver), Controller Manager (kube-controller-manager), etcd, Scheduler (kube-scheduler), Node components – Kubelet, Proxy (kube-proxy), Docker, Interaction between Kubernetes master and nodes.

**Kubernetes Resources:** Preparing the Environment, Kubectl, Kubernetes Objects – Namespace, Name, Label and Selector, Annotation, Pods, ReplicaSet (RS) and ReplicationController (RC), Deployments, Services, Volumes, Secrets, ConfigMap, Using ConfigMap via Volume, Using ConfigMap via Environment Variables.

## UNIT IV

**Kubernetes Volume and Resource Management:** Container Volume Lifecycle, Sharing Volume between Containers within a Pod, Stateless and Stateful Applications, Kubernetes Persistent Volume and dynamic provisioning, Replicating Pods with a Persistent Volume using StatefulSet, Persistent Volume examples, Resource Quality of Service, Configuring the BestEffort Pod, Configuring as the Guaranteed Pod, Configuring as Burstable Pod, Monitoring Resource Usage.

**Monitoring and Logging:** Inspecting a Container, Monitoring in Kubernetes – Application, Host, External Resources, Container, Kubernetes, Getting Monitoring Essentials for Kubernetes, Hands-on Monitoring – Meeting Prometheus, Deploying Prometheus, Working with PromQL, Discovering targets in Kubernetes, Gathering data from Kubernetes, Seeing metrics with Grafana, Logging Events - Patterns of Aggregating Logs, Collecting Logs with a Logging Agent per Node, Running a Sidecar Container to Forward Logs, Ingesting Kubernetes Events, Logging with Fluentd and Elasticsearch.

## TEXTBOOKS

1. J. Davis and R. Daniels, Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale, 1st ed., O'Reilly Media, Inc., 2016. [Unit I]
2. H. Saito, H.-C. C. Lee, and C.-Y. Wu, DevOps with Kubernetes: Accelerating Software Delivery with Container Orchestrators, Packt Publishing Ltd., 2019. [Unit II, III, IV]



**REFERENCE BOOKS**

1. M. Hering, DevOps for the Modern Enterprise: Winning Practices to Transform Legacy IT Organizations, IT Revolution, 2018.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Coursera, Introduction to DevOps, [Online]. Available: <https://www.coursera.org/learn/intro-to-devops> , Last accessed on: 04-04-2026.
2. Udemy, DevOps Fundamentals - CI/CD with AWS + Docker + Ansible + Jenkins, [Online]. Available: <https://www.udemy.com/course/devops-fundamentals-aws> , Last accessed on: 04-04-2026.

**23AI&DS7403D****ARCHITECTURE FOR MANAGEMENT OF LARGE DATASETS**

|                 |                                        |                   |       |
|-----------------|----------------------------------------|-------------------|-------|
| Course Category | PE IV                                  | Credits           | 3     |
| Course Type     | Theory                                 | L-T-P             | 3-0-0 |
| Prerequisites   | 23ES3304:Database Management & Systems | Continuous Eval   | 30    |
|                 |                                        | Semester End Eval | 70    |
|                 |                                        | Total Marks       | 100   |

**COURSE OUTCOMES**

1. Understand the fundamentals of Hadoop ecosystem, HDFS architecture, and demonstrate the ability to configure and set up a Hadoop cluster.
2. Understand Big Data terminologies and architectures, and maintenance of Hadoop systems.
3. Apply knowledge of Hive, Spark, Giraph, and analyze large-scale data using distributed computing frameworks.
4. Analyze different types of digital data and understand the concepts, architecture, and applications of Large Language Models and transformer-based systems.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                               |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                   |
| 1  | 3  | 2 | 1 | 1 | 3 |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.7.1, 2.6.4, 3.7.1, 4.4.2, 5.4.1 |
| 2  | 3  | 2 |   | 2 | 3 |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.7.1, 2.6.4, 4.4.2, 5.4.1        |
| 3  | 3  | 3 | 2 | 2 | 3 |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.7.1, 2.6.4, 3.7.1, 4.4.2, 5.4.1 |
| 4  | 3  | 3 | 2 | 2 | 3 |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.7.1, 2.6.4, 3.7.1, 4.4.2, 5.4.1 |

**COURSE CONTENT****UNIT I**

**Hadoop, HDFS and Setting up a Hadoop Cluster:** : Why Hadoop, Why not RDBMS, RDMBS vs Hadoop, HDFS Daemons, Anatomy of File Read, Anatomy of File Write, Replica Placement Strategy, Working with HDFS commands , Setting up a Hadoop Cluster-Cluster Specification, Cluster Setup and Installation, Hadoop Configuration, Security.

**UNIT II**

**Terminologies and Administering Hadoop:** Terminologies used in Big Data Environments - In-memory analytics, In-database processing, Symmetric Multiprocessor System(SMP), Massively Parallel Processing, Difference between Parallel and

Distributed Systems, Shared Nothing Architecture, Administering Hadoop- Administering HDFS, Monitoring and Maintenance.

### UNIT III

**Hive and Architecture of Graph:** What is Hive, Hive Architecture, Hive Data Types, Hive File Format, HiveQL, Tables, Querying Data, User Defined Functions (UDF), Architecture of Giraph Spark and Architecture of Storm: Installing Spark, Spark Applications, Jobs, Stages, Tasks, Resilient Distributed Datasets, Shared Variables, Anatomy of a Spark Job Run, Executors and Cluster managers, Architecture of Storm.

### UNIT IV

**Classification of Digital Data and Large Language Models for Graphs:** Classification of Digital Data - Structured Data, Semi-structured Data and Unstructured Data, Understanding large language models-What is an LLM, Applications of LLMs, Stages of building and using LLMs, Introducing the transformer architecture, Utilizing large datasets, A closer look at the GPT architecture, Building a large language model.

### TEXTBOOKS

1. S. Acharya and S. Chellappan, Big Data Analytics, 2nd ed., Wiley, 2015.
2. T. White, Hadoop: The Definitive Guide, 4th ed., O'Reilly, 2015.
3. V. K. Jain, Big Data and Hadoop, Khanna Book Publishing, 2020.
4. S. Raschka, Build a Large Language Model (From Scratch), September 2024, ISBN: 9781633437166.

### REFERENCE BOOKS

1. Michael Minelli, Michelle Chambers and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013
2. P. J. Sadalage, M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012
3. Storm <https://cds.iisc.ac.in/wp-content/uploads/DS256.2017.Storm&.Tutorial.pdf>
4. Giraph <https://cds.iisc.ac.in/wp-content/uploads/DS256.2017.L12.Pregel.pdf>

### E-RESOURCES AND OTHER DIGITAL MATERIALS

1. S. Ghosh, "Big Data Computing," NPTEL, IIT Kharagpur, 2020. [Online]. Available: [https://onlinecourses.nptel.ac.in/noc20\\_cs92/preview](https://onlinecourses.nptel.ac.in/noc20_cs92/preview). [Accessed: May 6, 2026].
2. I. Bhattacharya, "Scalable Data Science," NPTEL, IIT Kharagpur, 2018. [Online]. Available: [https://onlinecourses.nptel.ac.in/noc18\\_cs39/preview](https://onlinecourses.nptel.ac.in/noc18_cs39/preview). [Accessed: May 6, 2026].
3. M. P. Singh, "Introduction to Big Data," NPTEL, IIT Kanpur, 2019. [Online].

- Available: [https://onlinecourses.nptel.ac.in/noc19\\_cs63/preview](https://onlinecourses.nptel.ac.in/noc19_cs63/preview). [Accessed: May 6, 2026].
4. A. Kshemkalyani, “Distributed Systems,” NPTEL, IIT Guwahati, 2017. [Online]. Available: [https://onlinecourses.nptel.ac.in/noc17\\_cs42/preview](https://onlinecourses.nptel.ac.in/noc17_cs42/preview). [Accessed: May 6, 2026].
  5. R. Venkatesh Babu, “Data Science for Engineers,” NPTEL, IIT Madras, 2021. [Online]. Available: [https://onlinecourses.nptel.ac.in/noc21\\_cs69/preview](https://onlinecourses.nptel.ac.in/noc21_cs69/preview). [Accessed: May 6, 2026].

## 23AI&DS7404A

### AGILE METHODOLOGIES

|                 |                                    |                   |       |
|-----------------|------------------------------------|-------------------|-------|
| Course Category | PE V                               | Credits           | 3     |
| Course Type     | Theory                             | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS5404A: Software Engineering | Continuous Eval   | 30    |
|                 |                                    | Semester End Eval | 70    |
|                 |                                    | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand agile philosophy, agile values, and agile adoption in software development environments.
2. Apply Scrum practices to enable effective teamwork, collaboration, and iterative project delivery.
3. Apply XP practices, values, and principles to implement incremental design in software development.
4. Analyze Lean and Kanban methodologies to optimize workflow, manage process flow, and continuously improve software development practices.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                              |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                  |
| 1  | 2  |   |   |   |   |   |   |   |   |    |    |    |     |   | 2   | 1.7.1                            |
| 2  |    | 2 | 2 |   |   |   |   |   |   |    |    |    | 2   | 1 | 3   | 2.6.3,2.6.4<br>2.8.3,2.8.4,3.7.1 |
| 3  |    | 3 | 2 |   |   |   |   |   |   |    |    |    | 2   | 1 | 3   | 2.6.3,2.6.4<br>2.8.3,2.8.4,3.7.1 |
| 4  |    | 3 | 3 |   |   |   |   |   |   |    |    |    | 2   | 2 | 4   | 2.6.3,2.6.4<br>2.8.3,2.8.4,3.7.1 |

### COURSE CONTENT

#### UNIT I

**Learning Agile:** Agile, Getting Agile into your brain, Understanding Agile values, A fractured perspective, The Agile Manifesto, Understanding the Elephant, Where to start with a New Methodology.

**The Agile Principles:** The 12 Principles of Agile Software, The Customer Is Always Right, Delivering the Project, Better Project Delivery for the E-book Reader Project. Communicating and Working Together.

## UNIT II

**SCRUM and Self-Organizing Teams:** The Rules of Scrum, Act I: I Can Haz Scrum, Everyone on a Scrum Team owns the Project, Status Updates Are for Social Networks!, The Whole Team Uses the Daily Scrum, Feedback and the Visibility-Inspection-Adaptation Cycle, The Last Responsible Moment, Sprinting into a Wall, Sprints, Planning, and Retrospectives.

**Scrum Planning And Collective Commitment:** Not Quite Expecting the Unexpected, User Stories, Velocity, and Generally Accepted Scrum Practices, Victory Lap, Scrum Values Revisited.

## UNIT III

**XP and Embracing Change:** Going into Overtime, The Primary Practices of XP, The Game Plan Changed, but We're Still Losing, The XP Values Help the Team Change Their Mindset, An Effective Mindset Starts with the XP Values, The Momentum Shifts, Understanding the XP Principles Helps You Embrace Change.

**XP, Simplicity, and Incremental Design:** Code and Design, Make Code and Design Decisions at the Last Responsible Moment, Final Score.

## UNIT IV

**Lean, Eliminating Waste, and Seeing the whole:** Lean Thinking, Creating Heroes and Magical Thinking. Eliminate Waste; Gain a Deeper Understanding of the Product, Deliver As Fast As Possible.

**Kanban, Flow, and Constantly Improving:** The Principles of Kanban, Improving Your Process with Kanban, Measure and Manage Flow, Emergent Behavior with Kanban.

## TEXTBOOKS

1. Andrew Stellman, Jennifer Green, Head first Agile, O'Reilly, 2017.

## REFERENCE BOOKS

1. Rubin K , Essential Scrum : A Practical Guide To The Most Popular Agile Process, Addison-Wesley, 2013
2. Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly, 2015.

## E-RESOURCES AND OTHER DIGITAL MATERIALS

1. R. Mall, NPTEL Course on Software Engineering, [Online]. Available: <https://nptel.ac.in/courses/106105182/> , Last accessed on: 21/04/2026.
2. M. P. Ganesh and C. Dey, NPTEL Course on Working in Contemporary Teams, [Online]. Available: <https://nptel.ac.in/courses/110106167/> , Last accessed on: 21/04/2026.

## 23AI&DS7404B

### ROBOTIC PROCESS AUTOMATION

|                 |                                       |                   |       |
|-----------------|---------------------------------------|-------------------|-------|
| Course Category | PE-V                                  | Credits           | 3     |
| Course Type     | Theory                                | L-T-P             | 3-0-0 |
| Prerequisites   | 23ES1104: Introduction to Programming | Continuous Eval   | 30    |
|                 |                                       | Semester End Eval | 70    |
|                 |                                       | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the fundamentals and concepts of Robotic Process Automation (RPA).
2. Apply sequence and control flow structures to automate tasks.
3. Understand various mouse and keyboard automation activities in RPA.
4. Apply the design, deployment, and management of Assistant bots based on keyboard events.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                           |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                               |
| 1  | 2  | 2 |   |   | 2 |   |   |   |   |    |    |    | 2   | 2 | 2   | 1.6.1,2.6.3,5.4.1             |
| 2  | 3  | 2 | 2 |   | 3 |   |   |   |   |    |    |    | 3   | 2 | 3   | 1.7.1,2.6.4,3.7.1,5.4.1       |
| 3  | 2  | 2 |   | 1 | 3 |   |   |   |   |    |    |    | 2   | 3 | 2   | 1.7.1,2.6.4,4.4.2,5.4.1       |
| 4  | 3  | 3 | 3 | 2 | 3 |   |   |   |   |    |    |    | 3   | 3 | 3   | 1.7.1,2.6.4,3.7.1,4.4.2,5.4.1 |

#### COURSE CONTENT

##### UNIT I

**Introduction:** Scope and techniques of automation, Robotic process automation, Benefits of RPA, Components of RPA, RPA platforms, UiPath studio, UiPath Robot, UiPath orchestrator, the future of automation.

**Record and Play:** UiPath Stack, Types of Robots, the user interface, Quick Access Toolbar, Different panels, Task recorder, Step by step examples using recorder. Sequence, Activities, Control flow, various types of loops, decision making, step by step example using sequence and flow chart, step by step example using sequence and control flow.

##### UNIT II

**Data Manipulation and Controls:** Variables and Scope, Collections, Arguments, Data table usage, clipboard management, File operations, CSV/Excel to data table and vice versa. Finding and attaching windows, finding the control, techniques for a

waiting for a control, act on controls, mouse and keyboard activities, working with UiExplorer, Handling events, Screen scraping, OCR

### UNIT III

**Assistant Bots:** Assistant bots, Monitoring system event triggers, Hotkey trigger, Mouse trigger, System trigger Monitoring image and element triggers, Example of monitoring email, Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event.

**Exception Handling:** Exception Handling, common exceptions, logging and taking screenshots, Debugging techniques, collecting crash dumps, error reporting.

### UNIT IV

**Deploying and Maintaining the Bot:** Publishing using publish utility, publish a workflow in UiPath, Overview of Orchestration server, using orchestration server to control bots, using orchestration server to deploy bots, license management, publishing and managing updates.

### TEXTBOOKS

1. A. M. Tripathi, Learning Robotic Process Automation, Packt Publishing, 2018.

### REFERENCE BOOKS

1. Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston, “Introduction to Robotic Process Automation: a Primer”, Institute of Robotic Process Automation, 1st Edition 2015.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant”, Independently Published, 1st Edition 2018.
3. Srikanth Merianda,”Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation”, Consulting Opportunity Holdings LLC, 1st Edition 2018.
4. Lim Mei Ying, “Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes”, Packt Publishing, 1st Edition 2018.

### E-RESOURCES AND OTHER DIGITAL MATERIALS

1. UiPath, Robotic Process Automation, [Online]. Available: <https://www.uipath.com/rpa/robotic-process-automation> , Last accessed on:15-02-2026.  
UiPath Academy, UiPath Academy, [Online]. Available: <https://www.academy.uipath.com> , Last accessed on: 18-01-2026.



## 23AI&DS7404C

### REINFORCEMENT LEARNING

|                 |                                            |                   |       |
|-----------------|--------------------------------------------|-------------------|-------|
| Course Category | PE V                                       | Credits           | 3     |
| Course Type     | Theory                                     | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS5302:Principles of Machine Learning | Continuous Eval   | 30    |
|                 |                                            | Semester End Eval | 70    |
|                 |                                            | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand RL fundamentals and agent–environment framework interprets tasks.
2. Apply action-value methods to solve n-armed bandits to analyze stationary vs. non-stationary behavior.
3. Apply Model problems as finite MDPs to compute value functions and analyze optimality for episodic and continuing tasks.
4. Analyze classic RL case studies using Monte Carlo prediction and control (on/offpolicy with importance sampling).

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                               |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                   |
| 1  | 3  |   |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.7.1                             |
| 2  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.7.1, 2.6.3, 2.6.4, 3.7.1        |
| 3  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 3   | 1.7.1,2.5.2,2.8.3<br>2.8.4, 3.7.1 |
| 4  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.7.1,2.6.3, 2.6.4, 2.8.4, 3.7.1  |

#### COURSE CONTENT

##### UNIT I

**The Reinforcement Learning Problem:** Reinforcement Learning: Introduction and Motivation, Real-world Examples of Reinforcement Learning, Elements of Reinforcement Learning, Limitations and Scope of RL, Extended Example: Tic-Tac-Toe, Summary of the RL Framework, History of Reinforcement Learning.

##### UNIT II

**Multi-Armed Bandits:** The n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking a Non-stationary Problem, Optimistic Initial Values, Upper-Confidence-Bound (UCB) Action Selection, Gradient Bandits, Associative Search (Contextual Bandits).

**UNIT III**

***Finite Markov Decision Processes (MDPs):*** The Agent–Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Definition of Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation.

**UNIT IV**

***Monte Carlo Methods:*** Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-Policy Prediction via Importance Sampling, Incremental Implementation, Off-Policy Monte Carlo Control, Importance Sampling on Truncated Returns. Applications and Case Studies: TD-Gammon, Samuel’s Checkers Player, The Acrobot, Elevator Dispatching, Dynamic Channel Allocation, Job-Shop Scheduling.

**TEXTBOOKS**

1. R. S. Sutton and A. G. Barto, Reinforcement Learning: An Introduction, 2nd ed., The MIT Press, 2018.
2. M. Wiering and M. van Otterlo, Reinforcement Learning: State-of-the-Art (Adaptation, Learning, and Optimization, Vol. 12), 2012 ed.

**REFERENCE BOOKS**

1. V. François-Lavet, P. Henderson, and R. Islam, An Introduction to Deep Reinforcement Learning (Foundations and Trends in Machine Learning), 2019.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Prof. Balaraman Ravindran, IIT Madras – NPTEL Course on Reinforcement Learning, <https://nptel.ac.in/courses/106106143>, Last Accessed on 30/10/2025.
2. Balaraman Ravindran, IIT Madras – Lecture Notes on Reinforcement Learning, <https://dsai.iitm.ac.in/~ravi/nptel-courses/reinforcement-learning/>, Last Accessed on 30/10/2025.
3. Aritra Hazra, IIT KGP – Reinforcement Learning, <https://cse.iitkgp.ac.in/~aritrah/course/theory/RL/Autumn2022/>, Last Accessed on 30/10/2025.

## 23AI&DS7404D

### HIGH PERFORMANCE COMPUTING

|                 |                                                   |                   |       |
|-----------------|---------------------------------------------------|-------------------|-------|
| Course Category | PE V                                              | Credits           | 3     |
| Course Type     | Theory                                            | L-T-P             | 3-0-0 |
| Prerequisites   | 23AI&DS4304:Digital Logic & Computer Organization | Continuous Eval   | 30    |
|                 |                                                   | Semester End Eval | 70    |
|                 |                                                   | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand the fundamentals of parallel computing, including architectural trends, memory limitations, and performance considerations.
2. Apply principles of parallel algorithm design to decompose problems and map tasks efficiently for parallel execution.
3. Apply basic communication operations and synchronization techniques in shared memory parallel systems.
4. Analyze performance metrics and scalability issues in parallel systems using analytical models.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                                               |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-------------------------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                                   |
| 1  | 3  | 2 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.7.1, 2.6.3,2.6.4                                                |
| 2  | 3  | 3 | 2 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.7.1,2.6.3,2.6.4<br>2.8.3,2.8.4,3.7.1                            |
| 3  | 3  | 3 | 2 |   |   |   |   |   |   |    |    |    | 1   | 2 | 3   | 1.7.1,2.5.2,2.6.3<br>2.6.4,2.8.4,3.7.1                            |
| 4  | 3  | 3 | 3 |   |   |   |   |   |   |    |    |    | 1   | 2 | 4   | 1.6.1, 1.7.1, 2.5.1<br>2.5.2, 2.6.3, 2.8.2<br>3.5.1, 3.6.1, 3.6.2 |

### COURSE CONTENT

#### UNIT I

***Fundamentals of Parallel Computing & Architectures:*** Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Memory Limitations and System Performance Communication Costs in Parallel Machines, Scalable Design Principles, Architectures: N-wide Superscalar, Multi-core Architecture.

**UNIT II**

**Parallel Programming Principles GPU Basics:** Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Task Characteristics and Interactions, Mapping Techniques for Load Balancing, Methods for Reducing Interaction Overheads, Parallel Algorithm Models, Evolution of Parallel Processing, Introduction to GPU Computing.

**UNIT III**

**Communication Shared Memory Programming:** Basic Communication Operations: One-to-All Broadcast, All-to-One Reduction, All-Reduce and Prefix-Sum, Scatter and Gather Programming Shared Address Space Platforms: Threads (Basics) Synchronization Mechanisms OpenMP Programming.

**UNIT IV**

**Performance Analysis, Parallel Algorithms CUDA:** Analytical Models: Sources of Overhead in Parallel Programs, Performance Metrics, Granularity and Scalability, Minimum Execution Time and Cost, Matrix-Matrix Multiplication, Parallel Algorithms: Parallel Quick Sort, All-Pairs Shortest Path (basic concept).

**CUDA Programming:** CUDA Architecture (Overview) CUDA C Basics (Kernel Writing and Execution) GPU Memory Management Communication and Synchronization.

**TEXTBOOKS**

1. A. Grama, A. Gupta, G. Karypis, and V. Kumar, Introduction to Parallel Computing, 2nd ed., Addison-Wesley, 2003, ISBN: 0-201-64865-2.
2. J. Sanders and E. Kandrot, CUDA by Example, Addison-Wesley, ISBN-13: 978-0-13-138768-3.

**REFERENCE BOOKS**

1. K. Hwang, Scalable Parallel Computing, McGraw Hill, 1998, ISBN: 0070317984.
2. S. Cook, CUDA Programming: A Developer's Guide to Parallel Computing with GPUs, Morgan Kaufmann Publishers Inc., San Francisco, CA, USA, 2013, ISBN: 9780124159884.
3. D. Culler and J. P. Singh, Parallel Computer Architecture: A Hardware/Software Approach, Morgan Kaufmann, 1999, ISBN: 978-1-55860-343-1.
4. R. Stephens, Essential Algorithms, Wiley, ISBN: 978-1-118-61210-1.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. S. G. Srinivasa, NPTEL Course on Parallel Computer Architecture, [Online]. Available: <https://nptel.ac.in/courses/106106169/> , Last accessed on: 04/05/2026.
2. P. K. Sinha, NPTEL Course on Distributed Systems and Parallel Computing, [Online]. Available: <https://nptel.ac.in/courses/106106107/> , Last accessed on: 04/05/2026.

**23AI&DS7205A****OBJECT ORIENTED PROGRAMMING THROUGH JAVA**

|                 |                                       |                   |       |
|-----------------|---------------------------------------|-------------------|-------|
| Course Category | OE-III                                | Credits           | 3     |
| Course Type     | Theory                                | L-T-P             | 3-0-0 |
| Prerequisites   | 23ES1104: Introduction to Programming | Continuous Eval   | 30    |
|                 |                                       | Semester End Eval | 70    |
|                 |                                       | Total Marks       | 100   |

**COURSE OUTCOMES**

1. Understand the basic concepts of object oriented programming.
2. Interpret multiple inheritances through interfaces for a given application.
3. Apply exceptions, thread capabilities and handling files on a given application.
4. Illustrate the use of functional programming and Collections framework for a given application.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                                                  |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                                      |
| 1  | 2  | 3 |   |   |   |   |   |   |   |    |    |    |     |   | 2   | 1.7.1, 2.5.1, 2.5.2, 2.7.1                                           |
| 2  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.7.1, 3.5.1, 3.8.2                      |
| 3  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 3.8.2                      |
| 4  | 1  | 2 | 3 | 2 | 2 |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 3.6.2, 3.8.2, 4.6.2, 5.4.2 |

**COURSE CONTENT****UNIT I**

**Introduction, The History and Evolution of Java:** Java history and evolution, Java features, Java's Magic: Byte Code, How Java differs from C and C++.

**An Overview of Java:** Object Oriented Programming: Two paradigms, Principles of OOP, A First simple Program and Control statements. Data Types, Variables and Arrays: Java keywords, Primitive types, Integers, Floating-Point Types, Characters,

Booleans, Variables, Operators, Type Conversion, Casting and Arrays.

**Introducing Classes and Objects:** Class fundamentals, declaring objects, assigning object reference variables, introducing methods, constructors, this keyword, Garbage collection, overloading methods, using objects as parameters, returning objects, static and final keywords, nested and inner classes.

## UNIT II

**String Handling:** The String Constructors, String Buffer Class, String Tokenizer class.

**Inheritance:** Inheritance basics, using super, multilevel hierarchy, method overriding, dynamic method dispatch, using abstract classes, final with inheritance.

**Packages & Interfaces:** Defining a package, finding package and CLASSPATH. Access protection, importing packages, Defining an interface, implementing interfaces, nested interfaces, applying interfaces, variables in interfaces.

## UNIT III

**Exception handling:** Exception handling fundamentals, exception types, uncaught exceptions, using try and catch, multiple catch clauses, throw, throws, finally, creating your own exception subclasses.

**I/O streams:** Byte Streams- Input Stream, Output Stream, File Input Stream, File Output Stream, Character Streams- Reader, Writer, File Reader, and File Writer.

**Multithread Programming:** The Java Thread Model, Creating a thread: Implementing Runnable, Extending Thread, creating multiple threads, Thread Priorities, Synchronization- Using Synchronized methods, The synchronized Statement.

## UNIT IV

**Pragmatic Functional Programming using Lambdas:** Introduction to Functional programming, Functional Programming concepts and terminology, Functional Interfaces, Working with Lambda Expressions and Method References.

**Collections Framework:** Collections overview, Collection interfaces: Collection, List, and Set. Collection Classes: Array List, Linked List, Hash Set. Map Classes: Hash Map, Tree Map

**The Stream API:** Stream basics, Reduction operations, Using parallel streams, Mapping, Collecting, Iterators and Streams.

## TEXTBOOKS

1. Herbert Schildt, Java The Complete Reference, Oracle Press, 11th Edition, 2019.

## REFERENCE BOOKS

1. Herbert Schildt, Dale Skrien, Java Fundamentals: A Comprehension Introduction, McGraw-Hill Education India Pvt., Special Indian Edition, Ltd, 2017.
2. E Balaguruswamy, Programming with Java, Mc Graw Hill, 4th Edition, 2020.
3. Paul J. Dietel and Dr. Harvey M. Deitel, "Java How to Program", Deitel & Associates, 11th Edition, 2018.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Prof. Debasis Samanta, Department of Computer Science & Engineering, I.I.T. Kharagpur, Swayam, NPTEL, [https://onlinecourses.nptel.ac.in/noc21\\_cs03/preview](https://onlinecourses.nptel.ac.in/noc21_cs03/preview), Last Accessed On: 14/04/2026.
2. Evan Jones, Adam Marcus, Eugene Wu, *Introduction to Programming in Java*, MIT OpenCourseWare, Massachusetts Institute of Technology, <https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/>, Last Accessed On: 28/04/2026.
3. Prof. Owen Astrachan, *Object Oriented Programming in Java*, Duke University, Coursera, <https://www.coursera.org/specializations/object-oriented-programming>, Last Accessed On: 21/04/2026.
4. Dheeru Mundluru, *Java In-Depth: Become a Complete Java Engineer*, Udemy, <https://www.udemy.com/course/java-in-depth-become-a-complete-java-engineer/>, Last Accessed On: 14/04/2026.
5. Prof. Olufisayo Omojokun, *Introduction to OOPS with Java I: Foundations and Syntax Basics*, Georgia Institute of Technology, edX, <https://www.edx.org/certificates/professional-certificate/gtx-introduction-to-object-oriented-programming-with-java>, Last Accessed On: 04/05/2026.

## 23AI&DS7205B

### DATA SCIENCE WITH PYTHON

|                 |                 |                   |       |
|-----------------|-----------------|-------------------|-------|
| Course Category | OE-III          | Credits           | 3     |
| Course Type     | Theory          | L-T-P             | 3-0-0 |
| Prerequisites   | 23ES1104:       | Continuous Eval   | 30    |
|                 | Introduction to | Semester End Eval | 70    |
|                 | Programming     | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the fundamentals of Data Science including its process, algorithms, classification, data exploration techniques, descriptive statistics, and visualization methods.
2. Apply classification, regression, and association analysis techniques to analyze datasets and solve predictive and pattern discovery problems.
3. Apply clustering techniques and evaluate machine learning models using performance metrics such as confusion matrix, ROC, AUC, and lift curves.
4. Apply recommendation systems and time series forecasting methods for prediction, recommendation, and performance evaluation in real-world data science applications.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                      |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                          |
| 1  | 3  | 2 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.2.1, 1.7.1, 2.5.2                      |
| 2  | 1  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1, 3.6.1 |
| 3  | 2  | 2 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1        |
| 4  | 1  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1, 3.6.1 |

#### UNIT I

**Introduction to Data Science:** AI, Machine Learning and Data Science, What is Data Science, Case for Data Science, Data Science Classification, Data Science Algorithms, Roadmap for Data Science.

**Data Science Process:** Prior Knowledge, Data Preparation, Modeling, Application, Knowledge.

**Data Exploration:** Objectives of Data Exploration, Datasets, Descriptive Statistics, Data Visualization, Roadmap for Data Exploration.



**UNIT II**

**Classification:** Decision Trees, Rule Induction, k-Nearest Neighbors, Naïve Bayesian Methods, Artificial Neural Networks.

**Regression Methods:** Linear Regression, Logistic Regression.

**Association Analysis:** Market Basket Analysis, Mining Association Rules, Apriori Algorithm.

**UNIT III**

**Clustering:** Types of Clustering Techniques, K-Means Clustering, DBSCAN Clustering.

**Model Evaluation:** Confusion Matrix, ROC and AUC, Lift Curves, Model Implementation and Evaluation.

**UNIT IV**

**Recommendation Engines:** Collaborative Filtering, Content-Based Filtering, Hybrid Recommenders.

**Time Series Forecasting:** Time Series Decomposition, Smoothing Methods, Regression Based Methods, Machine Learning Methods, Performance Evaluation.

**TEXTBOOKS**

1. V. Kotu, B. Deshpande, Data Science: Concepts and Practice, 2nd Edition, Morgan Kaufmann, 2019.
2. J. Han, J. Pei, M. Kamber, Data Mining: Concepts and Techniques, 3rd Edition, Elsevier, 2011.

**REFERENCE BOOKS**

1. G. James, D. Witten, T. Hastie, R. Tibshirani, An Introduction to Statistical Learning, 1st Edition, Springer, 2013.
2. W. McKinney, Python for Data Analysis, 2nd Edition, O'Reilly Media, 2017.

**E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Data Science for Engineers, NPTEL, IIT Madras, 2026. Available at: [https://onlinecourses.nptel.ac.in/noc26\\_cs65/preview](https://onlinecourses.nptel.ac.in/noc26_cs65/preview), Last Accessed on: 02/05/2026.
2. Python for Data Science, NPTEL, IIT Madras, 2025. Available at: [https://onlinecourses.nptel.ac.in/noc25\\_cs104/preview](https://onlinecourses.nptel.ac.in/noc25_cs104/preview), Last Accessed on: 02/05/2026.
3. Introduction to Machine Learning, NPTEL, IIT Madras. Available at: <https://nptel.ac.in/courses>, Last Accessed on: 02/05/2026.

## 23AI&DS7205C

### AI TOOLS AND APPLICATIONS

|                 |                 |                   |       |
|-----------------|-----------------|-------------------|-------|
| Course Category | OE-III          | Credits           | 3     |
| Course Type     | Theory          | L-T-P             | 3-0-0 |
| Prerequisites   | 23ES1104:       | Continuous Eval   | 30    |
|                 | Introduction to | Semester End Eval | 70    |
|                 | Programming     | Total Marks       | 100   |

#### COURSE OUTCOMES

1. Understand the fundamentals of Artificial Intelligence, its evolution, core technologies, ecosystem, and role in society.
2. Apply AI tools and technologies for text generation, image generation, search, recommendation, and productivity applications in real-world domains.
3. Apply AI-driven automation, conversational AI, computer vision, speech and language processing, and emerging AI technologies.
4. Apply responsible AI practices by addressing ethical concerns, bias, transparency, security risks, regulations, and future trends in Artificial Intelligence.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                                                  |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                                                      |
| 1  | 2  | 3 |   |   |   |   |   |   |   |    |    |    |     |   | 2   | 1.7.1, 2.5.1, 2.5.2, 2.7.1                                           |
| 2  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.7.1, 3.5.1, 3.8.2                      |
| 3  | 2  | 2 | 3 |   |   |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 3.8.2                      |
| 4  | 1  | 2 | 3 | 2 | 2 |   |   |   |   |    |    |    | 2   | 2 | 3   | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 3.6.2, 3.8.2, 4.6.2, 5.4.2 |

#### COURSE CONTENT

##### UNIT I

**Introduction to Artificial Intelligence:** Journey of Artificial Intelligence, Evolution of AI, What is AI, Narrow AI and Artificial General Intelligence (AGI), AI vs

Traditional Programming.

**Core Technologies of AI:** Machine Learning, Pattern Recognition, Natural Language Processing, Computer Vision.

**AI Ecosystem and Foundations:** Types of AI Systems, Intelligent Applications and Role of AI in Society.

## UNIT II

**AI Tools and Technologies:** AI-powered Chatbots and Virtual Assistants, Text Generation Tools, Image Generation Tools, AI Search and Recommendation Tools, AI-based Productivity and Content Creation Tools.

**AI in Real-world Systems:** AI in Banking and Finance, Insurance, Healthcare, Retail and E-commerce, Manufacturing, Entertainment, Agriculture and Education.

## UNIT III

**AI-driven Automation and Applications:** Conversational AI, Computer Vision Applications, Speech and Language Processing, Smart Systems and Intelligent Decision Support.

**Emerging AI Technologies:** Generative AI, Human–AI Interaction, AI-enabled Automation and Intelligent Workflows.

## UNIT IV

**Challenges and Responsible AI:** Data Privacy, Bias and Fairness, Transparency and Explainability, Ethical Concerns, Accountability, Security Risks and Regulation Standards.

**Future of AI:** Job Transformation, Interoperability, Resource Challenges, Future Opportunities and Trends in Artificial Intelligence.

## TEXTBOOKS

1. Goswami, S., Das, A. K., & Chakrabarti, A., AI for Everyone: A Beginner's Handbook for Artificial Intelligence (AI), Pearson, 2024.
2. Russell, S., and Norvig, P., Artificial Intelligence: A Modern Approach, Pearson, 4<sup>th</sup> Edition, 2021.
3. Kapoor, A., and Gulli, A., Generative AI with Python and TensorFlow 2: Build Intelligent Applications using Generative Models, Packt Publishing, 2023.

## REFERENCE BOOKS

1. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans, Farrar, Straus and Giroux, 2019.
2. Michael Wooldridge, A Brief History of Artificial Intelligence: What It Is, Where We Are, and Where We Are Going, Flatiron Books, 2021.
3. Margaret A. Boden, Artificial Intelligence: A Very Short Introduction, Oxford University Press, 2<sup>nd</sup> Edition, 2018.
4. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pear-

son, 4<sup>th</sup> Edition, 2021.

5. Kris Jamsa, Introduction to Artificial Intelligence, Jones & Bartlett Learning, 2<sup>nd</sup> Edition, 2024.

## **E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Prof. Amit Sheth, Introduction to Artificial Intelligence, Department of Computer Science and Engineering, I.I.T. Kharagpur, Swayam, NPTEL, [https://onlinecourses.nptel.ac.in/noc25\\_cs53/preview](https://onlinecourses.nptel.ac.in/noc25_cs53/preview), Last Accessed On: 15/05/2026.
2. Andrew Ng, AI For Everyone, DeepLearning.AI, Coursera, <https://www.coursera.org/learn/ai-for-everyone>, Last Accessed On: 15/05/2026.
3. OpenAI, ChatGPT and Generative AI Resources, OpenAI, <https://openai.com/>, Last Accessed On: 15/05/2026.
4. Google Cloud, Introduction to Generative AI, Google Cloud Skills Boost, [https://www.cloudskillsboost.google/course\\_templates/536](https://www.cloudskillsboost.google/course_templates/536), Last Accessed On: 15/05/2026.
5. IBM Skills Network, Introduction to Artificial Intelligence (AI), IBM Cognitive Class, <https://cognitiveclass.ai/courses/introduction-to-artificial-intelligence-ai>, Last Accessed On: 15/05/2026.

## PROMPT ENGINEERING

|                 |              |                   |       |
|-----------------|--------------|-------------------|-------|
| Course Category | SEC          | Credits           | 2     |
| Course Type     | Theory & Lab | L-T-P             | 0-1-2 |
| Prerequisites   | –            | Continuous Eval   | 30    |
|                 |              | Semester End Eval | 70    |
|                 |              | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand fundamental concepts of prompt engineering and prompt design principles.
2. Apply advanced prompting techniques including few-shot, role-based and structured prompting and evaluate prompt outputs for accuracy, ethics, safety and robustness.
3. Analyze structured outputs and reasoning strategies for solving complex problems using LLMs.
4. Analyze retrieval-augmented and agent-based systems using modern frameworks.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                          |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                              |
| 1  | 1  | 1 |   |   |   |   |   |   |   |    |    |    | 1   | 1 | 2   | 1.2.1,1.7.1,2.8.1            |
| 2  | 1  | 2 | 2 |   |   |   |   |   |   |    |    |    | 1   | 1 | 3   | 1.2.1, 1.7.1, 2.8.1<br>3.6.2 |
| 3  | 1  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.2.1, 1.7.1, 2.5.2<br>3.6.2 |
| 4  | 1  | 2 | 3 |   |   |   |   |   |   |    |    |    | 1   | 1 | 4   | 1.2.1, 1.7.1, 2.8.1<br>3.6.2 |

### COURSE CONTENT

#### UNIT I

**Foundations of Prompt Engineering:** Definition of prompt engineering, Distinction between prompt engineering and model fine-tuning, Motivation and benefits of prompt engineering, Core principles of effective prompt design, Anatomy of a prompt, Setting up the Python environment for LLM interaction, Iterative prompting lifecycle, Common prompt pitfalls and remediation.

#### Lab Experiments:

- **Environment & Connectivity:** Install required packages (e.g., transformers, openai); securely configure the API key; run a simple “Hello, world” prompt to verify model access.
- **Baseline vs. Enhanced Prompts:** Execute a naïve prompt (“Write a one paragraph bio of Ada Lovelace.”) and an enhanced prompt that adds role framing, specificity, and explicit format instructions; compare both outputs for relevance, completeness, and style.
- **Iterative Refinement on a Simple Task:** Summarize the plot of the Shakespearean play Romeo and Juliet in two sentences through three rounds of prompt tweaking:
  - a. Minimal instruction.
  - b. Addition of length and style constraints
  - c. Specification of key content elements (setting and theme) Document how each iteration changes and improves the result.
- **Diagnosing Prompt Failures & Edge Cases:** Craft a vague or contradictory prompt; analyze the failure mode (ambiguity, missing context, or format errors); refine the prompt by adding examples or clarifying instructions.

## UNIT II

***Advanced Prompt Patterns, Techniques & Ethical Evaluation:*** Enhanced prompt anatomy: contextual detail and explicit output specifications, Few-shot in context prompting, Prompt structuring and template design, Role-based prompting to establish personas or system behavior, Negative prompting to filter or suppress undesired content, Constraint specification and instruction enforcement (e.g., length, format), Iterative prompt refinement and optimization.

#### Lab Experiments:

- **Few-Shot vs. Zero-Shot Comparison:** Design and execute a zero-shot prompt and a few-shot prompt (with 2–3 exemplar input-output pairs) for a chosen text task (e.g., sentiment classification or translation); compare outputs for accuracy, consistency, and adherence to examples.
- **Role-Based & Negative Prompting:** Craft a role-based prompt to establish a specific persona (e.g., “You are a financial advisor...”); then create a negative prompt to suppress undesired content (e.g., “Do not mention any brand names”); evaluate how each influences the model’s response.
- **Constraint Specification & Iterative Refinement:** Select an open-ended task (e.g., summarizing a technical article); issue a basic prompt; identify failures in length or format; refine the prompt by adding explicit constraints (word count, bullet format, etc.); document improvements over two refinement cycles.
- **Prompt Evaluation & Ethics Workshop:** Select two prompts and generate multiple outputs, evaluate them using manual heuristic checks for accuracy, relevance and format compliance; apply LLM-as-Judge prompts to automate evaluation; design a prompt injection test such as “Ignore previous instructions,” analyze the response and refine prompts to improve robustness.

### UNIT III

**Structured Output, Reasoning Techniques Agents, & Multimodal AI:** Importance of structured outputs for real-world applications, Prompting for specific formats such as lists, tables and Markdown, Generating valid JSON and YAML using explicit instructions, Eliciting chain-of-thought reasoning in zero-shot prompts, Decomposing complex tasks into manageable sub-tasks.

Lab Experiments:

- **Structured Format Prompting:** Instruct the model to output information as bullet lists and Markdown tables (e.g., “List three benefits of daily exercise in a Markdown table with columns ‘Benefit’ and ‘Description’”); verify that the output matches the requested structure.
- **JSON/YAML Generation:** Provide a brief dataset description (e.g., three books with title, author and publication year) and prompt the model to produce valid JSON or YAML; use a parser to validate syntax and refine the prompt if errors occur.
- **Chain-of-Thought & Task Decomposition:** Present a multi-step problem (e.g., a logic puzzle) and apply zero-shot chain-of-thought prompting (e.g., “Let’s think step by step. Explain your reasoning before the final answer”); decompose the problem into sequential sub-questions, collect partial answers, combine them and compare accuracy against a direct-answer baseline.
- **Building a Simple LLM Agent:** Register a tool such as a calculator function and design prompts that instruct the agent to invoke it when required; implement using LangChain or function-calling APIs and test with queries requiring tool usage.
- **Multimodal Prompting Exploration:** Generate images using detailed text prompts and provide the generated image to an image-understanding model with an appropriate prompt; compare the returned caption with the original prompt to evaluate alignment.

### UNIT IV

**Retrieval-Augmented Generation & LangChain Workflows:** Limitations of LLM internal knowledge, Need for external data sources, Introduction to Retrieval Augmented Generation, Overview of RAG architecture including indexing and retrieval with generation, Introduction to LangChain for LLM applications, Basics of LangChain Expression Language, Document loading and text splitting, Fundamentals of embeddings and vector stores, Building retrieval-generation pipelines.

Lab Experiments:

- **Building a Simple LCEL Chain:** Create a minimal LCEL script that accepts a fixed instruction (e.g., “Summarize this text”), passes it to an LLM and prints the result; verify end-to-end execution.
- **Basic Data Indexing for RAG:** Load a small collection of documents, split into uniform chunks (e.g., 200 tokens), generate embeddings for each chunk and store them in an in-memory vector store; inspect the results for consistency.

- **Constructing & Running a Basic RAG Chain:** Build a pipeline that receives a user query, retrieves the top-k relevant chunks, constructs a combined prompt with context and query, sends it to the LLM and returns the answer; test with sample queries and compare factual accuracy against a prompt without retrieval.



## CONSTITUTION OF INDIA

|                 |        |                   |       |
|-----------------|--------|-------------------|-------|
| Course Category | AC     | Credits           | 3     |
| Course Type     | Theory | L-T-P             | 3-0-0 |
| Prerequisites   | –      | Continuous Eval   | 30    |
|                 |        | Semester End Eval | 70    |
|                 |        | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

### COURSE CONTENT

#### UNIT I

**History of Making of the Indian Constitution:** History, Drafting Committee (Composition and Working).

**Philosophy of the Indian Constitution:** Preamble, Salient Features.

#### UNIT II

**Contours of Constitutional Rights and Duties:** Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

#### UNIT III

**Organs of Governance:** Parliament (Composition, Qualifications, Disqualifications, Powers and Functions), Executive (President, Governor, Council of Ministers), Judiciary (Appointment and Transfer of Judges, Qualifications, Powers and Functions).

#### UNIT IV

**Local Administration:** District Administration (Role and Importance), Municipalities (Mayor and Elected Representatives), Panchayati Raj (Zila Panchayat, Block Level, Village Level Administration), Importance of Grassroot Democracy.

**Election Commission:** Role and Functioning, Chief Election Commissioner and

Election Commissioners, State Election Commission. Welfare Bodies for SC/ST/OBC and Women.

### **TEXTBOOKS**

1. Government of India, “The Constitution of India (Bare Act)”, Government Publications, 1950.
2. S. N. Busi and B. R. Ambedkar, “Framing of Indian Constitution”, 1st Edition, 2015.

### **REFERENCE BOOKS**

1. M. P. Jain, “Indian Constitutional Law”, 7th Edition, LexisNexis, 2014.

### **E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Prof. Subhash Kashyap, “Indian Constitution”, NPTEL, Available: <https://nptel.ac.in/>, Last Accessed On: 05/05/2026.
2. National Portal of India, “Constitution of India”, Available: <https://www.india.gov.in/>, Last Accessed On: 05/05/2026.

## 23AI&DS7551 GENERATIVE AI LAB

|                 |                                         |                   |       |
|-----------------|-----------------------------------------|-------------------|-------|
| Course Category | PC Lab                                  | Credits           | 1     |
| Course Type     | Theory                                  | L-T-P             | 0-0-2 |
| Prerequisites   | 23AI&DS4353:Artificial Intelligence lab | Continuous Eval   | 30    |
|                 |                                         | Semester End Eval | 70    |
|                 |                                         | Total Marks       | 100   |

### COURSE OUTCOMES

1. Understand the evolution of generative modeling and to differentiate between discriminative and generative paradigms.
2. Understand the transformer architecture and its application in modern Large Language Models (LLMs).
3. Apply the principles of generative and multi-modal models including GANs, VAEs, and transformer-based image generation techniques.
4. Apply generative AI models and frameworks to build and deploy creative and video understanding applications.

*Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)*

| CO | PO |   |   |   |   |   |   |   |   |    |    |    | PSO |   | BTL | POI                                        |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--------------------------------------------|
|    | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1   | 2 |     |                                            |
| 1  | 3  | 2 |   |   |   |   |   |   |   |    |    |    | 2   | 1 | 2   | 1.2.1, 1.3.1, 1.7.1 2.1.1                  |
| 2  | 3  | 2 |   |   |   |   |   |   |   |    |    |    | 2   | 1 | 2   | 1.2.1, 1.3.1, 1.7.1, 2.1.1                 |
| 3  | 3  | 3 | 2 |   |   |   |   |   |   |    |    |    | 3   | 2 | 3   | 1.2.1, 2.1.1, 2.2.1, 3.1.1, 3.2.1          |
| 4  | 3  | 3 | 3 |   |   |   |   |   |   |    |    |    | 3   | 3 | 3   | 1.2.1, 1.7.1, 2.1.1<br>2.2.1, 2.7.2, 3.7.1 |

### COURSE CONTENT

**Task 1:** Implement and compare GANs, VAEs, and Autoregressive Models using a standard dataset such as MNIST or CIFAR-10. Analyze output quality, training stability, and computational complexity.

**Task 2:** Develop a Transformer-based text generation system using pretrained GPT models and evaluate generated text for coherence, fluency, and contextual relevance.

**Task 3:** Design and evaluate various prompt engineering techniques including zero-shot, few-shot, and chain-of-thought prompting for improving Large Language Model responses.

**Task 4:** Build a Retrieval Augmented Generation (RAG) chatbot capable of answering questions from uploaded documents using vector databases and embedding

models.

**Task 5:** Implement Stable Diffusion models for text-to-image generation and analyze the impact of prompt variations on image quality and semantic accuracy.

**Task 6:** Develop a Neural Style Transfer application to transform ordinary images into artistic styles using pretrained convolutional neural networks.

**Task 7:** Fine-tune an open-source Large Language Model such as LLaMA or GPT4All on a custom dataset for domain-specific text generation tasks.

**Task 8:** Create a multimodal AI application using CLIP and Vision Transformers for image captioning, image-text similarity, or visual question answering.

**Task 9:** Implement a music generation system using Recurrent Neural Networks or MuseGAN and evaluate generated musical sequences for rhythm and creativity.

**Task 10:** Deploy a Generative AI application using Hugging Face Transformers, LangChain, and Streamlit or Flask with support for user interaction and inference optimization.

## TEXTBOOKS

1. D. Foster, Generative Deep Learning, O'Reilly Books, 2024.
2. A. Rehmani, Generative AI for Everyone, BlueRose One, 2024.

## REFERENCE BOOKS

1. D. Rothman, Transformers for Natural Language Processing and Computer Vision, 3rd ed., Packt Books, 2024.

## E-RESOURCES AND OTHER DIGITAL MATERIALS

1. NPTEL, Deep Learning for Computer Vision, [Online]. Available: <https://onlinecourses.nptel.ac.in/noc25&cs93/preview> , Last accessed on: 10-04-2026.
2. NPTEL, Programming with Generative AI, [Online]. Available: <https://onlinecourses.nptel.ac.in/noc25&cs137/preview> , Last accessed on: 08-03-2026.