

# Amrutvahini College of Engineering, Sangamner Maharashtra, India



(An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune)

## Curriculum Structure and Syllabus Second Year B. Tech. Information Technology



### National Education Policy (NEP)-2020 Compliant Curriculum

(With effect from Academic Year 2026-27)

  
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## Abbreviation

AEC - Ability Enhancement Course

AICTE - All India Council for Technical Education

CEP - Community Engagement Project

EEM - Entrepreneurship/Economics/Management Courses

MDM - Multidisciplinary Minor

MOOC - Massive Open Online Course

NEP - National Education Policy

NPTEL - National Programme on Technology Enhanced Learning

OE - Open Elective

PCC - Program Core Course

CCC – Cocurricular Course

PEO - Programme Educational Objectives

PSO - Program Specific Outcomes

SWAYAM - Study Webs of Active-learning for Young Aspiring Minds

UGC - University Grants Commission

VEC - Value Education Course

VSE - Vocational and Skill Enhancement Course

WK - Knowledge and Attitude Profile

CCE - Comprehensive and Continuous Evaluation

ISO - International Organization for Standardization

EOMS - Educational Organization Management System

## Institute Vision

To create opportunities for rural students to become able engineers and technocrats through continual excellence in engineering education.

## Institute Mission

Our mission is to create self-disciplined, physically fit, mentally robust and morally strong engineers and technocrats with high degree of integrity and sense of purpose who are capable to meet challenges of ever advancing technology for the benefit of mankind and nature.

We, the management, the faculty and staff, therefore promise to strive hard and commit ourselves to achieve this objective through a continuous process of learning and appreciation of needs of time.

## Department Vision

To transfer the rural learners into competent I.T. engineers and technocrats in emerging areas of I.T. Engineering education through continual excellence for the benefit of society.

## Department Mission

**M1:** To empower the youths in rural communities to be self-disciplined, physically fit, mentally robust and morally strong I.T. professionals.

**M2.** To provide cutting-edge technical knowledge through continuous process in rapidly changing environment as per need of industry and surrounding world.

**M3:** To provide opportunities for intellectual and personal growth of individuals in rural platform using high quality Information Technology education.

  
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## ISO 21001:2018 - EOMS Policy

We, at AVCOE Sangamner, are committed to:

- Provide quality technical education to the rural students
- Provide conducive environment for all round development of the students.
- Develop as a premier institute for technical education & research as per the needs and expectations of all stake holders.
- Comply all applicable requirements.
- Develop students into technocrats having social responsibility.
- Keep abreast about the advances in technology and innovation.
- Enhance industry-institute interaction.
- Managing intellectual property.
- Maintain hygiene, health and safety for applicable requirements.
- Achieve continual improvement in academic and administrative processes.
- We shall strive to maintain Educational Organizational Management System.

## Knowledge and Attitude Profile

A Knowledge and Attitude Profile (KAP), often represented as WK (Knowledge and Attitude Profile) in some contexts, is a framework or assessment tool used to evaluate an individual's knowledge and attitudes related to a specific area, topic, or domain.

|     |                                                                                                                                                                                                                       |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WK1 | A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.                                                                              |
| WK2 | Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.         |
| WK3 | A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.                                                                                                            |
| WK4 | Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.              |
| WK5 | Knowledge, including efficient resource use, environmental impacts, whole- life cost, re-use of resources, net zero carbon, and similar Concepts, that supports engineering design and operations in a practice area. |

|     |                                                                                                                                                                                                                                                                                                  |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WK6 | Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.                                                                                                                                                                                              |
| WK7 | Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.                                                                            |
| WK8 | Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.                                                                                                        |
| WK9 | Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes. |

## Program Outcomes (POs)

|      |                                            |                                                                                                                                                                                                                                                                             |
|------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PO1  | Engineering knowledge                      | Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.                           |
| PO2  | Problem analysis                           | Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)                                                                  |
| PO3  | Design / Development of Solutions          | complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)                            |
| PO4  | Conduct Investigations of Complex Problems | Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).                                                                    |
| PO5  | Engineering Tool Usage                     | Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)                                                         |
| PO6  | The Engineer and The World                 | Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).                               |
| PO7  | Ethics                                     | Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)                                                                                                                           |
| PO8  | Individual and Collaborative Team work     | Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.                                                                                                                                                                       |
| PO9  | Communication                              | Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences |
| PO10 | Project Management and Finance             | Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.                                      |

|      |                    |                                                                                                                                                                                                                                            |
|------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PO11 | Life-Long Learning | Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8) |
|------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Program Educational Objectives (PEOs):

**PEO1:** Possess strong fundamental concepts in mathematics, science, engineering and Technology to address technological challenges.

**PEO2:** Possess knowledge and skills in the field of Computer Science and Information Technology for analyzing, designing and implementing complex engineering problems of any domain with innovative approaches.

**PEO3:** Possess an attitude and aptitude for research, entrepreneurship and higher studies in the field of Computer Science and Information Technology.

**PEO4:** Have commitment to ethical practices, societal contributions through communities and life-long learning.

**PEO5:** Possess better communication, presentation, time management and teamwork skills leading to responsible & competent professionals and will be able to address challenges in the field of IT at global level.

### Program Specific Outcomes (PSOs):

**A graduate of the Information Technology Program will demonstrate-**

**PSO-1:** Apply principles of science, mathematics along with programming paradigms and problem-solving skills using appropriate tools, techniques to expedite solution in I.T. domain.

**PSO-2:** Demonstrate core competencies related to I.T. domain of Data structures and algorithms, Software Engineering and Modeling, Hardware, Distributed Computing, Networking & security, Databases, Discrete mathematics and algebra, Machine Learning, Operating System.

**PSO-3:** Demonstrate leadership qualities and professional skills in modern I.T. platform for creating innovative carrier paths in placements, entrepreneurship and higher studies.

  
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## Preface

It gives me great pleasure to present the autonomous syllabus for Second Year B.Tech. Information Technology, introduced for the first time by the department under NEP-2020. The curriculum has been carefully designed to meet the latest requirements of the IT industry, emerging technologies, and modern higher education practices, while maintaining a strong academic foundation for students.

The syllabus aims to develop analytical thinking, technical skills, practical knowledge, creativity, and problem-solving abilities among students. Along with core subjects, the curriculum includes industry-oriented and updated courses related to Cyber Security, Web Technologies, E-Commerce Technologies, Data Ethics, Data Visualization, and other emerging areas in Information Technology. The curriculum also emphasizes outcome-based education, hands-on learning, laboratory practice, and project-based learning to improve students' employability and lifelong learning skills.

Thanks to all our Faculty Members, Academic Experts, Industry Professionals, Alumni and Board of Studies (BoS) Members for their valuable support and contributions in designing this curriculum. Their guidance has helped in developing the balanced and progressive syllabus that fulfils both academic and industry needs. This autonomous curriculum will help students gain strong technical knowledge, professional ethics, research skills and leadership qualities required for successful careers in the field of Information Technology.

I extend my best wishes to all students and faculty members for the successful implementation of this curriculum and for achieving excellence in their future endeavors.

Dr. B. L. Gunjal

Head, Department of Information Technology

Amrutvahini College of Engineering, Sangamner

(An Autonomous Institute affiliated to Savitribai Phule Pune University, Pune)

  
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## Program Codes:

The institute has assigned a unique program code to each branch.

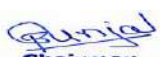
**Table-1: Program Codes**

| Sr. No. | Program Code           | Code |
|---------|------------------------|------|
| 1       | Information Technology | IT   |

## Subject code nomenclature:

The following nomenclature demonstrates the subject codes:

- **R-Year** of designing/revising syllabus
- **Program code:** as given in Table-1
- **Course Type:** As per NEP
- **Course Number:**
  - 101 – FY B. Tech Subject 1
  - 201 - SY B. Tech Subject 1
  - 301 - TY B. Tech Subject 1,
  - 401 - B. Tech Subject 1 etc.

  
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**Course Approval Summary:****AMRUTVAHINI COLLEGE OF ENGINEERING, SANGAMNER**

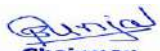
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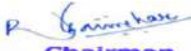
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| Sr. No. | Name of the course                                  | Course Code    | Course Incharges and Group Coordinators     |
|---------|-----------------------------------------------------|----------------|---------------------------------------------|
| 1       | Data Structures                                     | R25-IT-PCC-201 | Prof. P. S. Hase<br>Dr. B. L. Gunjal        |
| 2       | Fundamental of Computer Networks                    | R25-IT-PCC-202 | Prof. R. N. Muneshwar<br>Dr. B. L. Gunjal   |
| 3       | Computer Graphics                                   | R25-IT-PCC-203 | Prof. Y.R. Chikane<br>Dr. A.V. Markad       |
| 4       | Digital Electronics and Logic Design                | R25-IT-MDM-204 | Prof. N. S. Hodggar<br>Dr. U. R. Patole     |
| 5       | Open Elective I<br>(Cyber Security and Laws)        | R25-IT-OEC-205 | Dr. U. R. Patole                            |
| 6       | E-commerce: Technologies and Applications           | R25-IT-EEM-206 | Dr. P.M. Tambe<br>Dr. A. V. Markad          |
| 7       | Universal Human Values and Ethics                   | R25-IT-VEC-207 | Prof. R. A. Hande<br>Prof. R. N. Muneshwar  |
| 8       | Data Structures Laboratory                          | R25-IT-PCC-208 | Prof. P. S. Hase<br>Dr. B. L. Gunjal        |
| 9       | Computer Graphics Laboratory                        | R25-IT-PCC-209 | Prof. Y.R. Chikane<br>Dr. A.V. Markad       |
| 10      | Community Engagement Project                        | R25-IT-CEP-210 | Dr. A. V. Markad<br>Dr. B.L. Gunjal         |
| 11      | Database Management System                          | R25-CO-PCC-211 | Prof. A. D. Gawali<br>Dr. B. S. Borkar      |
| 12      | Applied Mathematics                                 | R25-IT-PCC-212 | Prof. S. S. Deshmukh<br>Dr. B. S. Borkar    |
| 13      | Object Oriented Programming                         | R25-IT-PCC-213 | Prof. S. R. Satpute<br>Dr. A. N. Nawathe    |
| 14      | Processor Architecture                              | R25-IT-MDM-214 | Prof. N. S. Hodgaukh<br>Dr. Uttam R. Patole |
| 15      | Open Elective II<br>(Data Ethics and Visualization) | R25-IT-OEC-215 | Dr. A. N. Nawathe<br>Dr. B.L. Gunjal        |

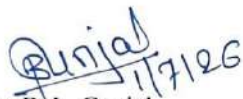
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| Sr. No. | Name of the course                           | Course Code    | Course Incharges and Group Coordinators  |
|---------|----------------------------------------------|----------------|------------------------------------------|
| 16      | Web Technologies                             | R25-IT-VSC-216 | Prof. R. A. Ghadge<br>Dr. U. R. Patole   |
| 17      | Modern Indian Language and Technical Writing | R25-IT-AEC-217 | Prof. S. C. Deshmukh<br>Dr. B. S. Borkar |
| 18      | Startup and Entrepreneurship                 | R25-IT-EEM-218 | Dr. A. V. Markad                         |
| 19      | Database Management System Laboratory        | R25-IT-PCC-219 | Prof. A. D. Gawali<br>Dr. B. S. Borkar   |
| 20      | Object Oriented Programming Laboratory       | R25-IT-PCC-220 | Prof. R. A. Bibave<br>Dr. A. N. Nawhate  |
| 21      | IPR and Patent Drafting                      | R25-IT-VEC-221 | Dr. B. L. Gunjal                         |

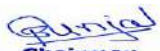
  
Dr. B. L. Gunjal  
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## Guidelines for Examination Scheme:

The evaluation of students shall be based on continuous academic performance in a course based on Comprehensive Continuous Evaluation (CCE) and End Semester Examination (ESE). Components of the Examination System:

### 1. Comprehensive Continuous Evaluation (CCE):

- CCE of 40 marks based on all the Units of course.
- To design a Comprehensive Continuous Evaluation scheme for a theory subject of 40 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

**Table 2: Allocation of marks & structure**

| Sr. No. | Examination                                                                                         | Conduction Marks | Marks | Coverage of Units                  |
|---------|-----------------------------------------------------------------------------------------------------|------------------|-------|------------------------------------|
| 1       | <b>CCE –I</b><br>(Class test – 1)                                                                   | 32               | 16    | Units 1 & Unit 2<br>(8 Marks/Unit) |
| 2       | <b>CCE –II</b><br>(Assessment tools: Case Study, presentation, Open book test etc.)                 | 32               | 16    | Units 3 & Unit 4<br>(8 Marks/Unit) |
| 3       | <b>CCE –III</b><br>(Assessment tools: Assignments, seminar, quiz, course project, field visit etc.) | 08               | 08    | Unit 5                             |

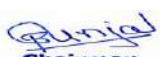
The distribution of marks across various assessment tools and their mapping to COs is detailed in the table below.

**Table 3: Allocation of marks & pattern for 3-Credit subjects**

| Exam         | Assessment                 | CO1       | CO2       | CO3       | CO4       | CO5       |
|--------------|----------------------------|-----------|-----------|-----------|-----------|-----------|
| <b>CCE1</b>  | Written Test (Units 1 & 2) | 8         | 8         | –         | –         | –         |
| <b>CCE2</b>  | Continuous Assessment*     | –         | –         | 8         | 8         | –         |
| <b>CCE3</b>  | Continuous Assessment*     | –         | –         | –         | –         | 8         |
| <b>ESE</b>   | Written Examination        | 12        | 12        | 12        | 12        | 12        |
| <b>Total</b> | <b>100 Marks</b>           | <b>20</b> | <b>20</b> | <b>20</b> | <b>20</b> | <b>20</b> |

**Table 4: Allocation of marks & pattern for 2-Credit subjects**

| Exam         | Assessment                 | CO1       | CO2       | CO3       | CO4       |
|--------------|----------------------------|-----------|-----------|-----------|-----------|
| <b>CCE1</b>  | Written Test (Units 1 & 2) | 10        | 10        | –         | –         |
| <b>CCE2</b>  | Continuous Assessment*     | –         | –         | 10        | 10        |
| <b>CCE3</b>  | Continuous Assessment*     | –         | –         | –         | –         |
| <b>ESE</b>   | Written Examination        | 15        | 15        | 15        | 15        |
| <b>Total</b> | <b>100 Marks</b>           | <b>25</b> | <b>25</b> | <b>25</b> | <b>25</b> |

  
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### Timeline for conduction of CCE:

- Weeks 1- 4 : Completion of Unit 1 and 2
- Week 5 : Conduct CCE1 1 (16 marks)
- Weeks 6 - 8 : Completion of Unit 3 and 4
- Week 9 : Conduct CCE2 as (16 marks)
- Weeks 10 - 12 : Completion of Unit 5
- Week 13 : Conduct Seminar/Course project/Presentation/Quiz/Open Book test (8 marks)

### Evaluation and Feedback:

- **Unit Test:** Student answer papers will be evaluated promptly, and constructive feedback will be provided highlighting strengths and areas for improvement.
- **Assignments / Case Study:** Student submissions will be assessed as per the given rubric, and meaningful feedback will be provided to help students understand their performance and scope for enhancement.
- **Seminar Presentation:** Students will be evaluated based on content accuracy, delivery, and responses during the Q&A session. Feedback will be shared on communication skills and conceptual understanding.
- **Open Book Test:** Evaluation will focus on the depth of analysis and the ability to apply concepts. Feedback will emphasize students' critical thinking and problem-solving skills.
- **Mini Project:** Students will be assessed on problem identification, design approach, implementation quality, and documentation. Innovation, teamwork, and practical application of concepts will be strongly considered.
- **Field Visit:** Evaluation will be based on the student's report and reflection, focusing on understanding of real-world practices and their relevance to the course outcomes. Marks will reflect clarity, insight, and active participation.

### 2. End Semester Examination (ESE):

The ESE is a compulsory examination for all students. The ESE examination will be conducted at the end of the semester by the institute Department of Examination and Evaluation (DEE). The ESE will be based on 100% syllabus (Unit 1 to Unit 5). The ESE shall be of 60 marks (12 Marks / Unit) conducted for all theory courses as mentioned in the programme structure.

**Syllabus Structure**

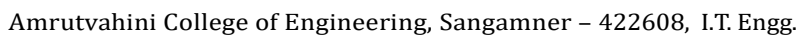
| Course Code    | Course Type                                           | Name of the Subject                                       | Teaching Scheme (Hrs./week) |    |     |                   |       | Examination Scheme and Marks |     |     |    |    |       | Credit |    |     |       |
|----------------|-------------------------------------------------------|-----------------------------------------------------------|-----------------------------|----|-----|-------------------|-------|------------------------------|-----|-----|----|----|-------|--------|----|-----|-------|
|                |                                                       |                                                           | TH                          | PR | TUT | Self-<br>Learning | Total | CCE                          | ESE | TW  | PR | OR | TOTAL | TH     | PR | TUT | TOTAL |
| Semester-III   |                                                       |                                                           |                             |    |     |                   |       |                              |     |     |    |    |       |        |    |     |       |
| R25-IT-PCC-201 | Program Core course – 1                               | <a href="#">Data Structures</a>                           | 3                           | -  | -   | 45                | 90    | 40                           | 60  | -   | -  | -  | 100   | 3      | -  | -   | 3     |
| R25-IT-PCC-202 | Program Core course – 2                               | <a href="#">Fundamental of Computer Networks</a>          | 3                           | -  | -   | 45                | 90    | 40                           | 60  | -   | -  | -  | 100   | 3      | -  | -   | 3     |
| R25-IT-PCC-203 | Program Core course – 3                               | <a href="#">Computer Graphics</a>                         | 3                           | -  | -   | 45                | 90    | 40                           | 60  | -   | -  | -  | 100   | 3      | -  | -   | 3     |
| R25-IT-MDM-204 | Multidisciplinary Course-1                            | <a href="#">Digital Electronics and Logic Design</a>      | 3                           | -  | -   | 45                | 90    | 40                           | 60  | -   | -  | -  | 100   | 3      | -  | -   | 3     |
| R25-IT-OEC-205 | Open Elective - 1                                     | To be chosen from OE-1 basket finalized at college level  | 2                           | -  | -   | 30                | 60    | 40                           | 60  | -   | -  | -  | 100   | 2      | -  | -   | 2     |
| R25-IT-EEM-206 | Entrepreneurship/Economics/Management course          | <a href="#">E-commerce: Technologies and Applications</a> | 1                           | 2  | -   | 15                | 60    | 25                           | -   | 25  | -  | -  | 50    | 1      | 1  | -   | 2     |
| R25-IT-VEC-207 | Value Education Course                                | <a href="#">Universal Human Values and Ethics</a>         | 2                           | -  | -   | 30                | 60    | 50                           | -   | -   | -  | -  | 50    | 2      | -  | -   | 2     |
| R25-IT-PCC-208 | Program Core Course-Lab                               | <a href="#">Data Structures Laboratory</a>                | -                           | 2  | -   | -                 | 30    | -                            | -   | 25  | 25 | -  | 50    | -      | 1  | -   | 1     |
| R25-IT-PCC-209 | Program Core Course Lab /Multidisciplinary Course-Lab | <a href="#">Computer Graphics Laboratory</a>              | -                           | 2  | -   | -                 | 30    | -                            | -   | 25  | 25 | -  | 50    | -      | 1  | -   | 1     |
| R25-IT-CEP-210 | Community Engagement Project / Field Project          | <a href="#">Community Engagement Project</a>              | -                           | 4  | -   | -                 | 60    | -                            | -   | 50  | -  | -  | 50    | -      | 2  | -   | 2     |
|                |                                                       |                                                           | 17                          | 10 | 0   | 255               | 660   | 275                          | 300 | 125 | 50 | 0  | 750   | 17     | 5  | 0   | 22    |



| Course Code    | Course Type                                  | Name of the Subject                                          | Teaching Scheme (Hrs./week) |    |     |               |       | Examination Scheme and Marks |     |    |    |    |       | Credit |    |     |       |
|----------------|----------------------------------------------|--------------------------------------------------------------|-----------------------------|----|-----|---------------|-------|------------------------------|-----|----|----|----|-------|--------|----|-----|-------|
|                |                                              |                                                              | TH                          | PR | TUT | Self-Learning | Total | CCE                          | ESE | TW | PR | OR | TOTAL | TH     | PR | TUT | TOTAL |
| Semester-IV    |                                              |                                                              |                             |    |     |               |       |                              |     |    |    |    |       |        |    |     |       |
| R25-CO-PCC-211 | Program Core course - 4                      | <a href="#">Database Management System</a>                   | 3                           | -  | -   | 45            | 90    | 40                           | 60  | -  | -  | -  | 100   | 3      | -  | -   | 3     |
| R25-IT-PCC-212 | Program Core course - 5                      | <a href="#">Applied Mathematics</a>                          | 2                           | -  | -   | 30            | 60    | 40                           | 60  | -  | -  | -  | 100   | 2      | -  | -   | 2     |
| R25-IT-PCC-213 | Program Core course - 6                      | <a href="#">Object Oriented Programming</a>                  | 3                           | -  | -   | 45            | 90    | 40                           | 60  | -  | -  | -  | 100   | 3      | -  | -   | 3     |
| R25-IT-MDM-214 | Multidisciplinary Course - 2                 | <a href="#">Processor Architecture</a>                       | 2                           | -  | -   | 30            | 60    | 40                           | 60  | -  | -  | -  | 100   | 2      | -  | -   | 2     |
| R25-IT-OEC-215 | Open Elective - 2                            | To be chosen from OE-2 basket finalized at college level     | 2                           | -  | -   | 30            | 60    | 40                           | 60  | -  | -  | -  | 100   | 2      | -  | -   | 2     |
| R25-IT-VSC-216 | Vocational Skill Course                      | <a href="#">Web Technologies</a>                             | 1                           | 2  | -   | 15            | 60    | -                            | -   | 25 | 25 | -  | 50    | 1      | 1  | -   | 2     |
| R25-IT-AEC-217 | Ability Enhancement Course                   | <a href="#">Modern Indian Language and Technical Writing</a> | 1                           | 2  | -   | 15            | 60    | -                            | -   | 50 | -  | -  | 50    | 1      | 1  | -   | 2     |
| R25-IT-EEM-218 | Entrepreneurship/Economics/Management course | <a href="#">Startup and Entrepreneurship</a>                 | 2                           | -  | -   | 30            | 60    | 50                           | -   | -  | -  | -  | 50    | 2      | -  | -   | 2     |
| R25-IT-PCC-219 | Program Core Course- Lab                     | <a href="#">Database Management System Laboratory</a>        | -                           | 2  | -   | -             | 30    | -                            | -   | -  | 25 | -  | 25    | -      | 1  | -   | 1     |
| R25-IT-PCC-220 | Program Core Course Lab                      | <a href="#">Object Oriented Programming Laboratory</a>       | -                           | 2  | -   | -             | 30    | -                            | -   | -  | 25 | -  | 25    | -      | 1  | -   | 1     |
| R25-IT-VEC-221 | Value Education Course                       | <a href="#">IPR and Patent Drafting</a>                      | 2                           | -  | -   | 30            | 60    | 50                           | -   | -  | -  | -  | 50    | 2      | -  | -   | 2     |
|                |                                              |                                                              | 18                          | 8  | 0   | 270           | 660   | 300                          | 300 | 75 | 75 | 0  | 750   | 18     | 4  | 0   | 22    |



# SEMESTER III



Rev.No:00, Date:19/6/2026

**Course Description:**

This course introduces the concepts of organizing and managing data efficiently using various data structures such as arrays, linked lists, stacks, queues, trees, and graphs. It also covers algorithms, performance analysis, and complexity evaluation using time and space complexity. Students learn to select suitable data structures and algorithms for solving computational problems effectively, developing skills required for efficient software development and real-world computing applications.

**Course Relevance:**

The course Data Structures is essential for IT students as it helps in organizing and processing data efficiently. It develops problem-solving, logical thinking, and programming skills needed to design optimized software solutions. DSA forms the foundation for advanced subjects like database management systems, operating systems, artificial intelligence, and software engineering. It is also widely used in modern applications such as cloud computing, data analytics, and large-scale software systems, preparing students for academic growth and professional IT careers.

**Prerequisite:**

Programming Fundamentals (C / C++) languages

**Bridge Contents:**

- Basic problem-solving techniques, algorithms and flowchart design
- Introduction to data organization and memory concepts

**Course Objective:**

1. To understand the fundamental concepts of data structures and analyze algorithm efficiency using time and space complexity.
2. To apply and implement searching and sorting techniques, heap structures, and linked list operations to efficiently manage data.
3. To Understand the concepts, operations, and applications of stack and queue data structures.
4. To analyze tree and graph data structures and apply appropriate traversal and graph algorithms to solve computational problems.
5. To understand advanced data structures and greedy algorithms used for solving complex computational problems efficiently.

**Course Outcomes:** After learning the course, students will be able to

| CO | Course Outcome | Bloom's Level |
|----|----------------|---------------|
|----|----------------|---------------|

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**Academic Council**  
Amrutvahini College of Engineering, Amrutnagar  
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|            |                                                                                                                                     |   |
|------------|-------------------------------------------------------------------------------------------------------------------------------------|---|
| <b>CO1</b> | <b>DISCUSS</b> the fundamental concepts of data structures and <b>ANALYZE</b> algorithm efficiency using time and space complexity. | 4 |
| <b>CO2</b> | <b>APPLY</b> searching and sorting techniques, heap structures, and linked list operations to manage data efficiently.              | 3 |
| <b>CO3</b> | <b>APPLY</b> stack and queue operations to solve problems, including expression conversion and evaluation.                          | 3 |
| <b>CO4</b> | <b>DISCUSS</b> tree and graph structures and <b>ANALYZE</b> traversal and graph algorithms for problem solving.                     | 4 |
| <b>CO5</b> | <b>APPLY</b> advanced data structures and greedy algorithm techniques to solve computational problems efficiently.                  | 3 |

| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                 |        |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|--------|-----|
| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Introduction to Data Structure                  | 9 Hrs. | CO1 |
| <p><b>Introduction:</b> Concept of data, Data object, Data structure, Concept of Primitive and non- primitive, linear and Nonlinear, static and dynamic, persistent and ephemeral data structures</p> <p><b>Introduction to algorithm design strategies:</b> Concepts of Divide and Conquer, Greedy Algorithms, Dynamic Programming</p> <p><b>Analysis of Algorithm:</b> Frequency count and its importance in analysis of an algorithm, Time complexity &amp; Space complexity of an algorithm Big 'O', 'Ω' and 'Θ' notations</p> <p><b>Templates and Containers:</b> Advantages of Generic Programming, Function and Class Templates, STL (Standard Template Library), Concept of Container, array using container</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <p><b>1. Listing Real world applications of Algorithmic Strategies:</b> Google search indexing, Data compression in ZIP files, ATM cash withdrawal systems, Sudoku solvers, Stock market analysis</p> <p><b>2. Contact Management in Mobile Phone :</b> A mobile phone stores the names, phone numbers, and email addresses of contacts.</p> <p><b>3. To-Do Task List Organizer:</b> A user wants to keep track of tasks to do in a day or week.</p> |                                                 |        |     |
| Unit 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Linear Data Structures: Arrays and Linked Lists | 9 Hrs. | CO2 |
| <p><b>Arrays:</b> Single and multidimensional array and address calculation.</p> <p><b>Linked Organization:</b> Concept of linked organization, Arrays versus Linked List, Singly Linked List, Doubly Linked List, Circular Linked List (Operations: Create, Display, Search, Insert, Delete).</p> <p><b>Searching methods:</b> Array, Linear and binary search algorithms</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                 |        |     |



**Sorting methods:** Bubble, insertion, Quick, Merge, Shell methods

**Exemplars/Case studies/Practical Applications and usage:**

**1. Listing Real world applications of Searching, Sorting, SLL, DLL, CLL :** Search engines, Student result ranking, Music playlists, E-commerce product listing, Undo and redo operations, Traffic light systems

**2. Student Marks Management:** A school wants to manage marks of students in multiple subjects and quickly find toppers.

**3. Book Inventory in a Library:** A library wants to manage thousands of books and quickly retrieve information by Book ID or title.

| Unit 3 | Linear Data Structures: Stacks and Queues | 9 hrs | CO3 |
|--------|-------------------------------------------|-------|-----|
|--------|-------------------------------------------|-------|-----|

**Stacks:** Stack operations, Implicit versus Explicit Stack Applications of Stack for Expression Conversion (infix, prefix and postfix), Postfix expression evaluation

**Queues:** Queue Operations, Circular Queue, Priority Queue, Double Ended Queue and their advantages

**Exemplars/Case studies/Practical Applications and usage:**

**1. Listing Real world applications of Stacks, Queues data structures:** Memory Management, Browser History, Customer Service Systems, Printer Queue

**2. Evaluation in Calculator :** A scientific calculator needs to evaluate mathematical expressions entered by users.

**3. Customer Service Queue Management Scenario:** A bank or call center manages customer service requests in order of arrival.

| Unit 4 | Non-Linear Data Structures: Tree and Graph | 9 hrs | CO4 |
|--------|--------------------------------------------|-------|-----|
|--------|--------------------------------------------|-------|-----|

**Tree-**Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, postorder, preorder), Huffman Coding, Binary search trees, Optimal Binary Search Trees, AVL trees, Concept of Expression Trees, threaded binary tree

**Graph-**Matrix Representation of Graphs, Breadth First Search, Depth First Search, Spanning Trees, Shortest path – Dijkstra Algorithm, Minimal spanning tree- Prim's and Kruskal's Algorithm, Graph connectivity, Graph matching, Graph colouring

**Exemplars/Case studies/Practical Applications and usage:**

**1. Listing Real world applications of Tress, Graphs data structures:** Organization Hierarchy, Social Networks, Airline Route Mapping



**2. File Directory System in Operating Systems:** An operating system manages files and folders in a hierarchical structure

**3. GPS Navigation System:** A GPS system finds the shortest route between two locations

|               |                                                       |              |            |
|---------------|-------------------------------------------------------|--------------|------------|
| <b>Unit 5</b> | <b>Advanced Data Structures and File Organization</b> | <b>9 hrs</b> | <b>CO5</b> |
|---------------|-------------------------------------------------------|--------------|------------|

**Heap:** Heap data structure, Min and Max Heap, Heap sort, applications of heap

**Hashing :** Hashing: hashing functions, chaining, overflow handling with and without chaining, open addressing: linear and quadratic probing, Perfect Hashing, Cuckoo Hashing, Universal Hashing

**File Handling:** Sequential Files, Random Access Files & Record Management, Indexing and Hashing Techniques in Files

**Exemplars/Case studies/Practical Applications and usage:**

**1. Listing Real World applications of Heaps and Files:** Memory Management, Online Gaming, Multimedia Storage

**2. Hashing for Student Database :** A university stores thousands of student records and wants fast access by student ID.

**3. Compression in File Storage :** A system needs to compress large text files efficiently.

#### Text Books

1. *Narasimha Karumanchi, Data Structures and Algorithms Made Easy, 5th Edition, CareerMonk Publications, 2023, ISBN: 9788193245279.*
2. *Reema Thareja, Data Structures and Algorithms, Oxford University Press, 2025, ISBN: 9789367252673.*
3. *Chandan Banerjee, Atanu Das, Data Structures and Algorithms in C and Python, Orient Blackswan, 2023, ISBN: 9788195400904.*
4. *Michael T. Goodrich, Roberto Tamassia, David M. Mount, Data Structures and Algorithms in C++, 2nd Edition, John Wiley & Sons, 2011, ISBN: 978-0-470-38327-8.*

#### Reference Books

1. *Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 4th Edition, MIT Press, 2022, ISBN: 9780262046305.*
2. *Michael T. Goodrich, Roberto Tamassia, David M. Mount, Data Structures and Algorithms in C++, 2nd Edition, John Wiley & Sons, 2011.*
3. *Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson*



Education, 2023, ISBN: 9780132847377.

4. Steven S. Skiena, The Algorithm Design Manual, 3rd Edition, Springer, 2020, ISBN: 9783030542559.

### Website Links

**1. Data Structures and Algorithms Design:** By Prof. Nitin Saxena, IIT Kanpur  
[https://onlinecourses.nptel.ac.in/noc25\\_cs81/preview](https://onlinecourses.nptel.ac.in/noc25_cs81/preview)

**2. Data Structures and Algorithms :** By Prof. Naveen Garg, IIT Delhi  
<https://nptel.ac.in/courses/106102064>

**3. Greedy Algorithm Tutorials**  
<https://www.wscubetech.com/resources/dsa/greedy-algorithms>

**4. Huffman Coding**  
<https://www.geeksforgeeks.org/dsa/huffman-coding-greedy-algo-3>

**5. Data Structures Virtual Lab – IIIT Hyderabad**  
<https://ds1-iiith.vlabs.ac.in>

### CO-PO-PSO Mapping

| CO  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   | 3   | 1   | 2   | 2   | 1   | 1   | -   | -   | 1    | 3    | 3    | 2    | 1    |
| CO2 | 2   | 3   | 2   | 2   | 3   | 1   | 1   | -   | -   | 1    | 3    | 3    | 3    | 1    |
| CO3 | 2   | 3   | 2   | 2   | 3   | 1   | 1   | -   | -   | 1    | 3    | 3    | 3    | 1    |
| CO4 | 3   | 3   | 2   | 3   | 3   | 2   | 1   | -   | -   | 1    | 3    | 3    | 3    | 2    |
| CO5 | 3   | 3   | 3   | 3   | 3   | 2   | 1   | -   | -   | 1    | 3    | 3    | 3    | 3    |
| Avg | 2.6 | 3   | 2   | 2.4 | 2.8 | 1.4 | 1   | -   | -   | 1    | 3    | 3    | 2.8  | 1.6  |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE |     |     |     |     | ESE |     |     |     |     |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|          | CO1 | CO2 | CO3 | CO4 | CO5 | CO1 | CO2 | CO3 | CO4 | CO5 |
|          | 8   | 8   | 8   | 8   | 8   | 12  | 12  | 12  | 12  | 12  |
| L1       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |
| L2       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |
| L3       | —   | √   | √   | —   | √   | —   | √   | √   | —   | √   |
| L4       | √   | —   | —   | √   | —   | √   | —   | —   | √   | —   |
| L5       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |
| L6       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |



**This course serves as a prerequisite for / maps with the following future courses:**

- Design and Analysis of Algorithms,
- Database Management Systems,
- Operating Systems,
- Computer Networks,
- Artificial Intelligence,
- Machine Learning,
- Compiler Design
- Advanced Data Structures.

**Job Mapping:**

**Job/Future opportunities that one can get after learning this course:**

- Software Developer / Engineer
- Data Analyst / Data Engineer
- System Programmer
- Machine Learning / AI Engineer
- Backend Developer
- Competitive Programmer
- Coding Expert



|                 |                                  |          |        |                    |                |    |    |
|-----------------|----------------------------------|----------|--------|--------------------|----------------|----|----|
| Program:        | S. Y. B. Tech: IT                |          |        | Semester:          | III            |    |    |
| Course:         | Fundamental of Computer Networks |          |        | Course Code:       | R25-IT-PCC-202 |    |    |
| Teaching Scheme |                                  |          |        | Examination Scheme |                |    |    |
| Lecture         | Practical                        | Tutorial | Credit | CCE                | ESE            | TW | PR |
| 03              | --                               | --       | 03     | 40                 | 60             | -- | -- |

**Course Description**

This course provides an understanding of computer networking concepts and communication architectures in interconnected systems. It covers the OSI reference model, layered network design, and communication modes such as simplex, half-duplex, and full-duplex. The course explains switching techniques including packet and circuit switching, network topologies, and networking devices like bridges, switches, routers, and modems. The Data Link Layer includes framing, error detection and correction methods, and flow control protocols. Concepts of IPv4, IPv6, subnetting, CIDR, and network layer protocols such as IP, ICMP, ARP, and routing algorithms are discussed. Transport layer protocols TCP and UDP are also studied with focus on reliable communication, flow control, and congestion management. Overall, the course develops the skills required to analyze and manage computer network systems effectively.

**Course Relevance:**

Computer Networks is a fundamental subject that supports modern communication systems by enabling data exchange between devices across the world. It is essential for understanding how the Internet works, including protocols, routing, switching, and addressing. The subject is highly relevant in areas such as cloud computing, cybersecurity, IoT, and web applications. It helps students learn how data is transmitted reliably using models like OSI and TCP/IP. Knowledge of networking is crucial for careers in network engineering, system administration, and software development. Overall, it forms the backbone of all digital communication technologies used in today's interconnected world.

**Prerequisite:**

Computer Fundamentals, Digital Electronics, Programming Fundamentals, Basic Mathematical Skills

**Bridge Content:**

- Basics of computer communication and data transmission.
- Introduction to network devices and Internet services
- Fundamentals of digital signals and data representation

**Course Objectives:**

1. To understand the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model
2. To identify and apply error detection and correction techniques.
3. To understand network layer protocols and standards, sub-netting



4. To understand the transport layer protocols
5. To discuss functioning of key protocols of Application Layer

**Course Outcomes:** After learning the course, students will be able to

| CO  | Course Outcome                                                                | Bloom's Level |
|-----|-------------------------------------------------------------------------------|---------------|
| CO1 | <b>DESCRIBE</b> Responsibilities, services offered by the OSI Model Framework | 2             |
| CO2 | <b>DISCUSS</b> fundamentals of Data Communications                            | 2             |
| CO3 | <b>DEMONSTRATE</b> Data Link Layer and Multiple Access Protocols              | 3             |
| CO4 | <b>DEMONSTRATE</b> and Apply Networks and Transport protocols                 | 3             |
| CO5 | <b>ANALYZE</b> Emerging Networking Technologies                               | 4             |

### Course Contents

|               |                                                         |               |            |
|---------------|---------------------------------------------------------|---------------|------------|
| <b>Unit 1</b> | <b>Introduction to Computer Networking Fundamentals</b> | <b>9 Hrs.</b> | <b>CO1</b> |
|---------------|---------------------------------------------------------|---------------|------------|

**Communication and Networking Basics:** Communication Systems: Overview of data transmission systems, Networks: Concept of interconnected devices for data exchange, categorized by scale (e.g., LAN, MAN, WAN) and structure. Topologies: Physical and logical arrangements of network nodes, such as star, ring, mesh, and hybrid. Protocols

**Network Design and Models:** Network Architecture: OSI Model: Overview of functions of 7 layers physical layer to application layers, TCP/IP Suite: A practical set of protocols for internet communication including IP, TCP, and application-layer protocols

### Exemplars/Case studies/Practical Applications and usage:

1. LAN setup in a laboratory connecting 4-5 Computers testing with files and printer sharing
2. Visit Campus Network: Identify Topologies, devices and communication flow

|               |                            |               |            |
|---------------|----------------------------|---------------|------------|
| <b>Unit 2</b> | <b>Data Communications</b> | <b>9 Hrs.</b> | <b>CO2</b> |
|---------------|----------------------------|---------------|------------|

**Signals and Data Conversion:** Signals: Characteristics of analog and digital waveforms used in data transmission. Digital-to-Digital, Analog-to-Digital, Digital-to-Analog, Analog-to-Analog, Transmission Modes: Communication directions, including simplex, half-duplex, and full-duplex.

**Modulation and Transmission Media:** Modulation: Amplitude, Frequency, Phase modulation. Multiplexing strategies: Frequency Division Multiplexing (FDM), Time Division Multiplexing (TDM). Transmission Media: Wired: Twisted pair, coaxial, optical fiber cables. Wireless: Radio waves, microwaves, infrared.



**Switching Techniques:** Circuit Switching, Packet Switching, Datagram Approach: Connectionless packet delivery. Virtual Circuit: Connection-oriented packet routing.

**Exemplars/Case studies/Practical Applications and usage:**

1. Analysis of fiber optics in high-speed internet compared with twisted pair/coaxial cables
2. Demonstration of Packet Switching in Video Streaming Platforms (YouTube/Netflix)

|               |                                                      |               |            |
|---------------|------------------------------------------------------|---------------|------------|
| <b>Unit 3</b> | <b>Data Link Layer and Multiple Access Protocols</b> | <b>9 Hrs.</b> | <b>CO3</b> |
|---------------|------------------------------------------------------|---------------|------------|

**Multiple Access Protocols and Ethernet:** Data Link Layer Services, Basics of ALOHA protocols, Basics of CSMA/CD protocols, Ethernet LANS, Access Control:TDM, CSMA/CD, and Channelization (FDMA, TDMA, and CDMA).

**LAN Connectivity and Error Detection:**

Connecting LAN and back-bone networks- Repeaters, Hubs, Switches, Bridges, Router and Gateways, Error Detection and Correction: Checksum, CRC, Data Link Control: Framing, Flow and Error Control

**Channel Protocols and PPP:**

Noiseless Channels, Noisy channels, Stop and Wait ARQ, Sliding Window Protocol, Go Back N, Selective Repeat, HDLC, Point-to-Point Protocol.

**Exemplars/Case studies/Practical Applications and usage:**

1. Study of Ethernet in campus networks.
2. Study Wi-Fi Congestion: Observe Wi-Fi network slowdown in campus when many users access Wi-Fi simultaneously.

|               |                                      |               |            |
|---------------|--------------------------------------|---------------|------------|
| <b>Unit 4</b> | <b>Networks and Transport Layers</b> | <b>9 Hrs.</b> | <b>CO4</b> |
|---------------|--------------------------------------|---------------|------------|

**Network Layer:** Network Layer Services, Logical Addressing: IPv4 and IPv6 addressing, Network Address Translation (NAT), Sub-netting, Supernetting, CIDR notation. Network Layer Protocols: IP, DHCP, ICMP, IGMP, ARP, RARP, Fragmentation, Routing Protocols: Distance Vector, Link State, and Path Vector, Transition from Iv4 to IPv6

**Transport Layer:**

UDP: user datagram, UDP operation: connectionless services, flow and error control, encapsulation and decapsulation, queuing.

TCP: TCP services: process to process communication, stream delivery service, sending and receiving buffers, segments, full duplex communication. TCP features: sequence numbers and acknowledgement number, TCP segment, TCP connection, flow control, error control, congestion control.

**Exemplars/Case studies/Practical Applications and usage:**

1. Comparative of IPv4/IPv6 adoption in modern networks.
2. TCP versus UDP in Gaming and Video Calls: Compare why online games prefer UDP while file downloads use TCP.



| Unit 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Overview of Networking Technologies | 9 Hrs. | CO5 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------|-----|
| <p><b>OSI/TCP-IP Layer Protocols:</b> Overview of DNS, Overview of WWW, URL, Email architecture,</p> <p><b>Application layers:</b> DNS, SMTP, POP, FTP, HTTP, Remote Logging, Electronic Mail, and File Transfer, Basic Concept of WiFi</p> <p><b>Emerging Networking Technologies:</b></p> <p><b>Wireless Connectivity:</b> Technologies like Wi-Fi (802.11 standards) and Bluetooth for short range communication. Mobile networks: Evolution from 4G to 5G, enabling high-speed, low latency communication.</p> <p><b>Cloud Networking:</b> Fundamentals of cloud-based network architectures. Concepts of virtualization, software-defined networking (SDN), Network Function Virtualization (NFV).</p> <p><b>Internet of Things (IoT):</b> Basics of IoT network frameworks and protocols (e.g., MQTT, CoAP). Applications of IoT in smart devices, home automation, and industrial systems.</p> |                                     |        |     |
| <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <ol style="list-style-type: none"> <li>1. Analysis of HTTP in web browsing. Study of DNS, HTTP, URL, WWW</li> <li>2. Study IoT-Based Smart Home Automation System: smart bulbs, Alexa/Google Home, and mobile-controlled appliances.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                     |        |     |
| <p><b>Textbooks:</b></p> <ol style="list-style-type: none"> <li>1. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, 6th Edition, 2021, McGraw-Hill Education, ISBN: 9781264363353.</li> <li>2. Behrouz A. Forouzan &amp; Firouz Mosharraf, Computer Networks: A Top-Down Approach, 1st Edition, 2023, McGraw Hill India, ISBN: 9789355324900.</li> <li>3. Behrouz A. Forouzan, TCP/IP Protocol Suite, 4th Edition, 2009, McGraw-Hill, ISBN: 9780073376042.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                              |                                     |        |     |
| <p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Andrew S. Tanenbaum, Nick Feamster &amp; David J. Wetherall, <i>Computer Networks</i>, 6th Edition, 2021, Pearson Education, ISBN: 9780136764052.</li> <li>2. James F. Kurose &amp; Keith W. Ross, <i>Computer Networking: A Top-Down Approach</i>, 8th Edition, 2021, Pearson Education, ISBN: 9781292405469.</li> <li>3. Larry L. Peterson &amp; Bruce S. Davie, <i>Computer Networks: A Systems Approach</i>, 6th Edition, 2021, Morgan Kaufmann, ISBN: 9780128182000.</li> </ol>                                                                                                                                                                                                                                                                                                                                         |                                     |        |     |
| <p><b>Website Links/ Online Resources</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                     |        |     |



1. **Computer Networks and Internet Protocol, Prof. Soumya Kanti Ghosh Prof. Sandip Chakraborty, IIT Kharagpur, <https://nptel.ac.in/courses/106105183>**
2. **IIT Virtual Labs -Computer Network Lab, IIT Delhi <https://cn-iitr.vlabs.ac.in/>**
3. **Introduction to Basic of Networking: Sri Vasana V.S., IIT Madras <https://www.youtube.com/watch?v=AozdnphXIU>**

**CO-PO-PSO Mapping**

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | -   | -    | 3    | 2    | 2    | 2    |
| CO2  | 3   | 2   | 2   | 2   | 2   | 1   | -   | 1   | -   | -    | 3    | 2    | 3    | 3    |
| CO3  | 3   | 3   | 3   | 3   | 3   | 2   | 1   | 2   | -   | -    | 3    | 2    | 3    | 3    |
| CO4  | 3   | 3   | 3   | 3   | 3   | 2   | 1   | 2   | -   | -    | 3    | 2    | 3    | 3    |
| CO5  | 3   | 3   | 3   | 3   | 3   | 2   | 1   | 2   | -   | -    | 3    | 3    | 3    | 3    |
| Avg. | 3   | 2.4 | 2.4 | 2.4 | 2.4 | 1.6 | 1   | 1.6 | -   | -    | 3    | 2.2  | 2.8  | 2.8  |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Assessment Pattern |     |     |     |     |     |     |     |     |     |     |
|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| BT Level           | CCE |     |     |     |     | ESE |     |     |     |     |
|                    | CO1 | CO2 | CO3 | CO4 | CO5 | CO1 | CO2 | CO3 | CO4 | CO5 |
|                    | 8   | 8   | 8   | 8   | 8   | 12  | 12  | 12  | 12  | 12  |
| L1                 | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |
| L2                 | √   | √   | —   | —   | —   | √   | √   | —   | —   | —   |
| L3                 | —   | —   | √   | √   | —   | —   | —   | √   | √   | —   |
| L4                 | —   | —   | —   | —   | √   | —   | —   | —   | —   | √   |
| L5                 | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |
| L6                 | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |

This course serves as a prerequisite for maps with the following future courses:

- Computer Network Security
- Cloud Computing
- Internet of Things



- Wireless Communication
- Distributed Systems
- Computer Network Management
- Network Programming
- Web Technologies
- Cloud Computing
- Mobile Computing

**Job Mapping:**

**Job/Future opportunities that one can get after learning this course:**

- Network Administrator
- System Administrator
- Technical Support Engineer
- IT Infrastructure Engineer
- Network Administrator
- Cyber Security Analyst
- Cloud Support Associate
- Wireless Network Technician
- IoT Support Engineer
- Data Center Technician
- Server Administrator
- Cloud Infrastructure Associate





|                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                     |        |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                     | Level  |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                           | Discuss fundamental concepts and identify hardware components in computer graphics. | 2      |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                           | Apply algorithms to draw and fill basic geometric shapes.                           | 3      |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                           | Apply mathematical transformations and projections techniques on graphical objects. | 3      |     |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                           | Implement techniques for polygon filling, clipping, and color modeling              | 3      |     |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                           | Implement interactive graphics and animations.                                      | 3      |     |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                     |        |     |
| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                        | Computer Graphics Basic, OpenGL                                                     | 9 Hrs. | CO1 |
| <b>Introduction Computer Graphics:</b> Introduction, basics of graphics systems, raster and random scan, basic display processor, significance, and applications, Display devices: CRT, LCD, LED; frame buffer, resolution, aspect ratio, aliasing and anti-aliasing<br><br><b>Graphics Primitives:</b> Pixel, line, circle, polygon basics.<br><b>OpenGL</b> – Introduction – Graphics function, OpenGL Interface, primitives and attributes |                                                                                     |        |     |
| <b>Exemplars/Case studies/Practical Applications and usage:</b><br>GLUT, OpenGL Architecture Review Board (ARB)                                                                                                                                                                                                                                                                                                                               |                                                                                     |        |     |
| Unit 2                                                                                                                                                                                                                                                                                                                                                                                                                                        | Rasterization, Polygon Filling and 2 D Clipping                                     | 9 Hrs. | CO2 |
| <b>Scan Conversion Algorithms:</b> Line drawing: DDA, Bresenham's, Circle drawing: Bresenham's, Midpoint<br><br><b>Polygon Filling Algorithms:</b> Polygons and its types, inside test, Boundary fill, Flood fill, scan line fill.<br><b>2D clipping:</b> Cohen-Sutherland, Sutherland-Hodgeman                                                                                                                                               |                                                                                     |        |     |
| <b>Exemplars/Case studies/Practical Applications and usage:</b><br>Transformation of an Object in Computer Graphics: Mathematical Matrix Theory                                                                                                                                                                                                                                                                                               |                                                                                     |        |     |
| Unit 3                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2D, 3D Transformations                                                              | 9 Hrs. | CO3 |
| <b>2D Transformations:</b> Translation, Scaling, Rotation, Reflection and Shearing, Matrix representation and homogeneous coordinate system, composite transformations.<br><br><b>3D Transformation:</b> Translation, scaling, rotation about X, Y, Z & arbitrary axis, and reflection about XY, YZ, XZ.                                                                                                                                      |                                                                                     |        |     |
| <b>Exemplars/Case studies/Practical Applications and usage:</b><br>Transformation of an Object in Computer Graphics: Mathematical Matrix Theory, Guard-band clipping technique and its use in rendering software.                                                                                                                                                                                                                             |                                                                                     |        |     |



| Unit 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Projections, Color models and Shading           | 9 Hrs. | CO4 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|--------|-----|
| <p><b>Projections:</b> Types of projections- Parallel, Perspective<br/> <b>Parallel:</b> oblique – Cavalier, Cabinet, Orthographic – isometric, diametric, trimetric</p> <p><b>Illumination models:</b> Light sources, ambient light, diffuse light, specular reflection<br/> <b>Color Models:</b> CIE Chromaticity Diagram, RGB, CMY, HSV color models.<br/> <b>Shading:</b> Gouraud and Phong shading.</p>                                                                                                                                                         |                                                 |        |     |
| <p><b>Exemplars/Case studies/Practical Applications and usage:</b><br/>         Use of transformations and projections in any real time software</p>                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                 |        |     |
| Unit 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Curves, Fractals, Animation and Virtual reality | 9 Hrs. | CO5 |
| <p><b>Curves:</b> Introduction, interpolation and approximation, Spline Interpolation Methods – Bezier curves, B-Splines.</p> <p><b>Fractals:</b> Introduction, Classification, fractal Dimension, Fractal dimension and surfaces, Hilbert curve, Koch Curve.</p> <p><b>Basics of animation:</b> Definition and 12 principles, animation languages, key frame, morphing, motion specification</p> <p><b>Introduction of Virtual Reality:</b> Fundamental Concept, Three I's of virtual reality and Classic Components of VR systems, Applications of VR systems.</p> |                                                 |        |     |
| <p><b>Exemplars/Case studies/Practical Applications and usage:</b><br/>         Study of Gaming platforms (NVIDIA, i8060), advances in gaming, Open-source tools: Unity, Maya, Blender</p>                                                                                                                                                                                                                                                                                                                                                                           |                                                 |        |     |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                 |        |     |
| <p>1. D. Hearn, M. Baker, “Computer Graphics – C Version”, Pearson Education, 4th Edition, 2011, ISBN81 – 7808 –794 – 4</p> <p>2. Grigore C. Burdea, Philippe Coiffet, “Virtual Reality Technology”, 3rd Edition (2024) Wiley India Edition, ISBN 81-265-0789-6</p>                                                                                                                                                                                                                                                                                                  |                                                 |        |     |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                 |        |     |
| <p>1. D. Rogers, “Procedural Elements for Computer Graphics”, 4nd Edition, Tata McGraw-Hill Publication, 2011, ISBN 0 – 07 – 047371 – 4.</p> <p>2. J. Foley, V. Dam, S. Feiner, J. Hughes, “Computer Graphics Principles and Practice”, 4nd Edition, Pearson Education, 20013, ISBN 81 – 7808 – 038 – 9.</p> <p>3. “Computer Graphics: Principles &amp; Practice in C” by James D. Foley, Andries van Dam, Steven K. Feiner, and John F. Hughes (2nd Edition, ISBN: 9788131705056), 3rd Edition, 2013.</p>                                                           |                                                 |        |     |



4. “Computer Graphics Using OpenGL” by F. S. Hill Jr. (Pearson Education), Latest Edition: 3rd Edition (2006 / ©2007)

#### Website Links/ Online Resources

1. Introduction to Computer Graphics by David J. Eck

<https://open.umn.edu/opentextbooks/textbooks/420>

2. Computer Graphics: Prof. Samit Bhattacharya, IIT Guwahati

<https://nptel.ac.in/courses/106103224>

3. Introduction to Computer Graphics, Prof. Prem K Kalra, IIT Delhi

<https://nptel.ac.in/courses/106102065>

#### CO-PO-PSO Mapping

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7  | PO8  | PO9  | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|
| CO1  | 3   | 3   | 3   | 2   | 2   | 1   | 2    | 1    | -    | 1    | 1    | 2    | 2    | 2    |
| CO2  | 3   | 3   | 3   | 2   | 2   | 2   | -    | -    | 2    | 2    | 2    | 2    | 2    | 3    |
| CO3  | 3   | 3   | 3   | 2   | 2   | 2   | -    | -    | -    | -    | 1    | 2    | 2    | 3    |
| CO4  | 2   | 3   | 1   | 2   | 1   | 2   | 1    | 2    | 1    | 1    | -    | 2    | 2    | 3    |
| CO5  | 2   | 3   | 1   | 2   | 1   | 2   | 1    | 2    | 1    | 1    | -    | 2    | 2    | 2    |
| Avg. | 2.6 | 3   | 2.2 | 2   | 1.6 | 1.8 | 1.34 | 1.67 | 1.34 | 1.25 | 1.34 | 2    | 2    | 2.66 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

#### Assessment Pattern

| BT Level | CCE |     |     |     |     | ESE |     |     |     |     |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|          | CO1 | CO2 | CO3 | CO4 | CO5 | CO1 | CO2 | CO3 | CO4 | CO5 |
|          | 8   | 8   | 8   | 8   | 8   | 12  | 12  | 12  | 12  | 12  |
| L1       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |
| L2       | √   | —   | —   | —   | —   | √   | —   | —   | —   | —   |
| L3       | —   | √   | √   | √   | √   | —   | √   | √   | √   | √   |
| L4       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |
| L5       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |
| L6       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |

**This course serves as a prerequisite for maps with the following future courses:**

- Advanced Computer Graphics
- Multimedia Systems
- Image Processing
- Computer Vision
- Animation and Visual Effects
- Virtual Reality and Augmented Reality



- Game Design and Development

**Job Mapping:**

**Job/Future opportunities that one can get after learning this course:**

- Computer Graphics Engineer
- Graphics Programmer
- Game Developer
- Animator (2D / 3D)
- Visual Effects (VFX) Artist
- Multimedia Designer
- UI/UX Designer
- Web Graphics Designer
- Image Processing Engineer
- Computer Vision Engineer
- AR/VR Developer
- Simulation and Modeling Engineer





|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                               |                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>CO2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Apply <b>Boolean algebra and logic minimization techniques</b> to design digital circuits.                                    | <b>3</b>          |
| <b>CO3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Differentiate combinational and sequential circuits and use flip flops for various applications                               | <b>4</b>          |
| <b>CO4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Implement Sequential Circuits.                                                                                                | <b>3</b>          |
| <b>CO5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Explain the organization and architecture of computer systems</b> , including CPU, memory hierarchy, and I/O organization. | <b>2</b>          |
| <b>Course Contents</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                               |                   |
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Introduction to Digital Electronics</b>                                                                                    | <b>9 Hrs. CO1</b> |
| <p><b>Digital Logic families:</b> Digital IC Characteristics; TTL: Standard TTL characteristics, CMOS: Standard CMOS characteristics Comparison of TTL &amp; CMOS.</p> <p><b>Signed Binary number representation and Arithmetic:</b> Sign Magnitude, 1's complement &amp; 2's complement representation, unsigned Binary arithmetic (addition, subtraction, multiplication, and division), subtraction using 2's complement; IEEE Standard 754 Floating point number representations. Codes: Binary, BCD, octal, hexadecimal, Excess-3, Gray code &amp; their conversions and applications of codes.</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <ol style="list-style-type: none"> <li>1. CMOS 4000 series ICs</li> <li>2. Practical applications of various codes in computers.</li> </ol> |                                                                                                                               |                   |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Combinational Logic Design</b>                                                                                             | <b>9 Hrs. CO2</b> |
| <p><b>Logic minimization:</b> Representation of truth-table, SOP form, POS form, Simplification of logical functions, Minimization of SOP and POS forms, don't care Conditions.</p> <p><b>Reduction techniques:</b> K-Maps up to 4 variables CLC design using SSI chips – Code converters, Half- Adder, Full Adder, Half Subtractor, Full Subtractor</p> <p><b>Introduction to MSI functions &amp; chips-</b>Multiplexers (IC 74151 and IC 74153), Demultiplexer (IC 74138), Comparators and their applications.</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <ol style="list-style-type: none"> <li>1. Design of a Digital Safe Lock System</li> <li>2. Design of a Digital Voting System using Logic Minimization and MSI Chips</li> </ol>                                                  |                                                                                                                               |                   |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Flip Flops and Counters</b>                                                                                                | <b>9 Hrs. CO3</b> |
| <p><b>Introduction to sequential circuits.</b> Difference between combinational circuits and sequential circuits, memory element – latch.</p> <p><b>Flip- Flops:</b> Design, truth table, excitation table of SR, JK, D, T flip flops. Conversion from one type to another type of flip flop. Study of flip flop ICs - 7473, 7474, 7476</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                               |                   |



**Application of flip-flops** – Bounce elimination switch, Counters- asynchronous, synchronous and modulo counters, Study of modulus n counter ICs- 7490 & their applications to implement mod counters

**Exemplars/Case studies/Practical Applications and usage:**

1. Design of a Digital Stopwatch Using Sequential Circuits
2. Digital Traffic Light Control System Using Sequential Circuits

|               |                                                |               |            |
|---------------|------------------------------------------------|---------------|------------|
| <b>Unit 4</b> | <b>Introduction to Sequential Logic Design</b> | <b>9 Hrs.</b> | <b>CO4</b> |
|---------------|------------------------------------------------|---------------|------------|

**Registers-** Buffer register, shift register types - SISO, SIPO, PISO & PIPO, applications of shift registers - ring counter, twisted ring counter

**Basic design steps-**State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation

Sequence generators using counters & sequence detector using Moore & Mealy model

**Exemplars/Case studies/Practical Applications and usage:**

1. Shift Register in Serial Communication
2. Sequence Detector Using Moore Model

|               |                                              |               |            |
|---------------|----------------------------------------------|---------------|------------|
| <b>Unit 5</b> | <b>Fundamentals of Computer Organization</b> | <b>9 Hrs.</b> | <b>CO5</b> |
|---------------|----------------------------------------------|---------------|------------|

**Computer architecture:** organization, functions & types of computer units- CPU (typical organization, Functions, Types), Memory (Types & their uses in computer), IO (types & functions) & system bus (Address, data & control, Typical control lines, Multiple-Bus Hierarchies)

**Programmable Logic Devices:** PLD, ROM as PLD, Programmable Logic array (PLA): Implementation procedure, Construction and working, Programmable Array Logic (PAL): Architecture, Programming PAL's, construction and working and their applications.

**Exemplars/Case studies/Practical Applications and usage:**

1. Computer Architecture of a Modern Personal Computer, Control Unit Design in Computer Systems
2. Traffic Light Control System Using PLD

**Textbooks:**

1. R.P. Jain, "Modern Digital Electronics", Tata McGraw-Hill, 4th Edition, 2010, ISBN: 978-0070688575.
2. William Stallings, Prentice Hall "Computer organization and architecture, designing for performance", Pearson Education, **11th Edition**, 2018, ISBN: 978-0134997193.
3. Moris Mano, Digital Logic and Computer Design, Pearson Education, **5th Edition**, 2016, ISBN: 978-9332573055.

**Reference Books:**

- 1.M Morris Mano, “Digital Design”, Prentice Hall, 6th Edition, 2017, ISBN: 978-9332585485.
2. Hamacher and Zaky, Computer organization, McGraw-Hill Education, 6th Edition, 2011, ISBN: 978-0073380650.

**Website Links/ Online Resources**

1. Digital System Design by Prof. Neeraj Goel, IIT Ropar  
[https://onlinecourses.nptel.ac.in/e-learning/preview/noc24\\_ee17](https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ee17)
2. Digital Electronic Circuits by Prof. Goutam Saha, IIT Kharagpur  
[https://onlinecourses.nptel.ac.in/e-learning/preview/noc25\\_ee20](https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee20)

**CO-PO-PSO Mapping:**

| CO/<br>PO | PO1 | PO2 | PO3  | PO4  | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|------|------|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1       | 3   | 2   | –    | –    | –   | –   | –   | –   | –   | –    | –    | 3    | 1    | --   |
| CO2       | 3   | 2   | 3    | 1    | –   | –   | –   | –   | –   | –    | –    | 3    | 2    | 1    |
| CO3       | 3   | 2   | 2    | 1    | –   | –   | –   | –   | –   | –    | –    | 2    | 2    | 1    |
| CO4       | 3   | 2   | 3    | 2    | 1   | –   | –   | –   | –   | –    | –    | 2    | 3    | 1    |
| CO5       | 2   | 1   | –    | –    | –   | –   | –   | –   | –   | –    | –    | 2    | 1    | 2    |
| Avg.      | 2.8 | 1.8 | 2.66 | 1.33 | 1   | -   | -   | -   | -   | -    | -    | 2.4  | 1.8  | 1.25 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Assessment Pattern**

| BT Level | CCE |     |     |     |     | ESE |     |     |     |     |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|          | CO1 | CO2 | CO3 | CO4 | CO5 | CO1 | CO2 | CO3 | CO4 | CO5 |
|          | 8   | 8   | 8   | 8   | 8   | 12  | 12  | 12  | 12  | 12  |
| L1       | –   | –   | –   | –   | –   | –   | –   | –   | –   | –   |
| L2       | –   | –   | –   | –   | √   | –   | –   | –   | –   | √   |
| L3       | √   | √   |     | √   |     | √   | √   |     | √   |     |
| L4       | –   | –   | √   | –   | –   | –   | –   | √   | –   | –   |
| L5       | –   | –   | –   | –   | –   | –   | –   | –   | –   | –   |
| L6       | –   | –   | –   | –   | –   | –   | –   | –   | –   | –   |

**This course serves as a prerequisite for maps with the following future courses:**

- Processor Architecture
- Internet of Things (IoT)
- Operating Systems
- Artificial Intelligence
- Cloud Computing



**Job Mapping:**

**Job/Future opportunities that one can get after learning this course:**

- Hardware Design Engineer
- Embedded Systems Engineer
- VLSI Design Engineer
- Microprocessor / Microcontroller Engineer
- Computer Hardware Engineer
- Robotics and Automation Engineer
- Research and Higher Studies.





|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                       |                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>CO4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ANALYZE modern E-Commerce applications and security challenges, and suggest suitable mechanisms for secure and efficient digital business operations. | <b>4</b>          |
| <b>Course Contents:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                       |                   |
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Fundamentals of E-Commerce and E-Business</b>                                                                                                      | <b>3 Hrs. CO1</b> |
| <p>Definition, scope, and features of E-Commerce, Types of E-Commerce (B2B, B2C, C2C, C2B), Digital markets and digital goods, Traditional commerce vs. E-Commerce, E-Commerce trade cycle, Advantages and limitations of E-Commerce, Concept and characteristics of E-Business, Evolution and impact of E-Business.</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <p>1. E-Commerce Website Design and Marketplace Analysis: Amazon, Flipkart: Website structure, business models, user interaction features for online commerce platforms.</p> <p>2. Digital business operations: eBay Consumer to Consumer(C2C) Marketplace Model, Alibaba's Business to Business(B2B) Global Trade Platform</p>                                                                                                            |                                                                                                                                                       |                   |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Technology Infrastructure of E-Commerce</b>                                                                                                        | <b>4 Hrs. CO2</b> |
| <p>Overview of E-Commerce infrastructure, Hardware and software technologies used in E-Commerce, Website as an online business platform, Cloud computing in E-Commerce, DevOps practices for scalable E-Commerce systems, Security and monitoring tools, E-Business Model Development and tools: Business Model Canvas (BMC), Canva tool, BMC Templates, PayPal Sandbox /Stripe Test API.</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <p>1. Amazon Web Services Cloud Infrastructure for E-Commerce:<br/>AWS provides scalable cloud computing service like servers, storage, databases used for e-commerce platforms</p> <p>2. Google Cloud in Digital Business Operations:<br/>Businesses with data analytics, hosting, AI services, infrastructure for smooth online operations and decision-making.</p> |                                                                                                                                                       |                   |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>E-Commerce Payment Systems</b>                                                                                                                     | <b>4 Hrs. CO3</b> |
| <p>Introduction to electronic payment systems, Traditional vs. online payment models, Types of E-Commerce payment systems, Digital wallets and mobile payment technologies, Payment gateways and service providers, Security in online payment systems, Regulatory framework: Reserve Bank of India (RBI guidelines), Trends in digital payment systems: Unified Payments Interface (UPI, contactless payments).</p>                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                       |                   |

**Exemplars/Case studies/Practical Applications and usage:**

1.Google Pay UPI-Based Transaction System and PhonePe Mobile Wallet Ecosystem: secure digital payment processing on E-Commerce platforms.

2.PayPal Secure Online Payment Gateway and Paytm Digital Payment Ecosystem in India: Workflow, Services and secured transactions on E-Commerce platforms.

|               |                                             |               |            |
|---------------|---------------------------------------------|---------------|------------|
| <b>Unit 4</b> | <b>E-Commerce Applications and Security</b> | <b>4 Hrs.</b> | <b>CO4</b> |
|---------------|---------------------------------------------|---------------|------------|

Introduction to modern E-Commerce applications, Online marketplaces and mobile commerce applications, Customer relationship and support systems in E-Commerce, Cloud-based E-Commerce services and applications, Business applications of E-Commerce systems, Security threats and vulnerabilities in E-Commerce, Authentication, encryption and secure transactions, Data privacy and protection mechanisms.

**Exemplars/Case studies/Practical Applications and usage:**

1. Customer Support & CRM Security in E-Commerce Platforms: Customer Relationship Management (CRM) systems, chatbots, AI-based support tools to ensure data privacy

2. General Data Protection Regulation (GDPR) on E-Commerce platforms: Protect customer information from misuse or breaches on E-Commerce platforms

**List of Practical**

|                        |                                         |              |            |
|------------------------|-----------------------------------------|--------------|------------|
| <b>Experiment No.1</b> | <b>Static E-Commerce Website Design</b> | <b>2 Hrs</b> | <b>CO1</b> |
|------------------------|-----------------------------------------|--------------|------------|

**Objective:**

Understand the structure of E-Commerce websites.

**Associated Tasks:**

- Create webpage layout with logo and navigation menu
- Display product categories and featured products
- Implement using HTML/CSS

**Exemplars and Utility:**

A basic e-commerce website is designed using HTML and CSS. It helps in understanding the standard structure of e-commerce websites, improves knowledge of webpage organization and navigation flow and builds basic front-end development skills required for designing user-friendly online shopping interfaces.

|                        |                                              |              |            |
|------------------------|----------------------------------------------|--------------|------------|
| <b>Experiment No.2</b> | <b>Product Catalog and Search Simulation</b> | <b>2 Hrs</b> | <b>CO2</b> |
|------------------------|----------------------------------------------|--------------|------------|

**Objective:**

Understand product organization and search mechanisms.

**Associated Tasks:**

Create a menu-driven product catalog system to add, display and search products using Product ID or Product Name using C/C++.

**Exemplars and Utility:**

A menu-driven product catalog system is developed using C/C++ where users can add product details. It demonstrates product organization, search functionality and basic E-Commerce catalog management.

Such online product search and catalog systems used in platforms such as Amazon and Flipkart.

**Experiment No.3****E-Commerce Order Processing System****2 Hrs****CO2****Objective:**

Understand transaction and order management logic.

**Associated Tasks:**

- Design a menu-driven order processing system using C/C++.
- Implement product selection and quantity handling
- Generate customer bill and order summary

**Exemplars and Utility:**

A menu driven E-Commerce Order Processing System using C/C++ implemented with product selection and quantity handling. The system generates customer bill and order summary. It demonstrates basic E-Commerce transaction workflow, billing logic and order management systems used in online shopping platforms

**Experiment No.4****Shopping Cart System****2 Hrs****CO2****Objective:**

Understand shopping cart and checkout functionality.

**Associated Tasks:**

- Add products to cart
- Remove products from cart
- Update product quantity
- Calculate and display total bill using C/C++

**Exemplars and Utility:**

A shopping cart system is developed using C/C++ where users can add, remove and update product quantities and calculate the total bill at checkout. Such workflows are used in online shopping cart of Amazon/Flipkart, also in grocery or bookstore cart system. It demonstrates cart management and billing logic used in E-Commerce applications.

**Experiment No.5****Digital Payment Workflow Simulation****2 Hrs****CO2****Objective:**

Understand E-Commerce payment mechanisms.

**Associated Tasks:**

Simulate customer login/authentication, payment processing, payment confirmation and generation of transaction status (success/failure) using C/C++.

**Exemplars and Utility:**

The payment system is simulated using C/C++ where the user logs in, processes payment, and receives a success or failure transaction status. It reflects real-world systems like UPI, ATM transactions and online checkout platforms such as Amazon or Flipkart. This experiment helps understand the basic workflow and logic of secure digital payment systems used in E-Commerce platforms.

**Experiment No.6****Designing a Business Model Canvas for an E-Commerce Idea****2 Hrs****CO2****Objective:**

Use the Business Model Canvas (BMC) to outline a business model for a hypothetical E-Commerce startup.

**Associated Tasks:**

- Identify customer segments, value proposition, and revenue model for an E-Commerce startup.
- Develop a Business Model Canvas (BMC) using suitable templates and tools.

**Exemplars and Utility:**

A Business Model Canvas (BMC) is created for a hypothetical e-commerce startup. Real-world examples include Amazon Marketplace, Flipkart, Meesho and Shopify-based startups. This demonstrates e-commerce business planning, startup strategy and the development of digital business models in a structured format.

**Experiment No.7****Login Authentication and Security Features****2 Hrs****CO4****Objective:**

Understand security mechanisms used in E-Commerce.

**Associated Tasks:**

- Implement username and password validation using Python
- Apply password masking and input verification techniques
- Simulate CAPTCHA-based authentication for secure login
- Demonstrate basic secure user authentication practices in E-Commerce systems

**Exemplars and Utility:**

A secure login system is implemented using Python where users authenticate using username and password validation along with password masking, input verification and CAPTCHA-based check.



It simulates security measures used in real e-commerce platforms. The experiment helps to understand secure login mechanisms and authentication practices used in modern E-Commerce applications.

|                        |                                          |              |            |
|------------------------|------------------------------------------|--------------|------------|
| <b>Experiment No.8</b> | <b>Log Analysis and Threat Detection</b> | <b>2 Hrs</b> | <b>CO4</b> |
|------------------------|------------------------------------------|--------------|------------|

**Objective:** Understand E-Commerce security monitoring.

**Associated Tasks:**

Analyze sample server log files to identify repeated failed login attempts, suspicious access requests and unusual login patterns using Python-based log analysis.

**Exemplars and Utility:**

A log analysis system is implemented using Python to examine server log files and detect security threats such as repeated failed login attempts, suspicious access requests and unusual login patterns. The system processes log data to identify anomalies and flag potential risks. This demonstrates threat detection, security monitoring and identification of suspicious activities in E-Commerce systems.

|                        |                                               |              |            |
|------------------------|-----------------------------------------------|--------------|------------|
| <b>Experiment No.9</b> | <b>Website Traffic and Customer Analytics</b> | <b>2 Hrs</b> | <b>CO3</b> |
|------------------------|-----------------------------------------------|--------------|------------|

**Objective:**

Understand E-Commerce analytics and customer behavior.

**Associated Tasks:**

Analyze sample website visitor data to identify page visits, customer activity and product popularity using Python.

**Exemplars and Utility:**

The system demonstrates website traffic and Customer Analytics, customer engagement tracking and popular product identification. It simulates customer behavior, website performance and business decision-making in E-Commerce platforms.

|                         |                     |              |                      |
|-------------------------|---------------------|--------------|----------------------|
| <b>Experiment No.10</b> | <b>Mini Project</b> | <b>6 Hrs</b> | <b>CO2, CO3, CO4</b> |
|-------------------------|---------------------|--------------|----------------------|

Following are example statements based on real-world applications but not limited to:

**Mini Project 1: Product Recommendation and Customer Analysis System**

**Problem Statement:** Develop a recommendation system using Python, Pandas or any other similar tools that analyzes sample customer browsing or purchase data and suggests relevant products based on predefined rules or basic machine learning logic.

**Mini Project 2: E-Commerce Security and Threat Monitoring Dashboard**

**Problem Statement:** Develop a dashboard using Python, HTML/CSS that monitors failed login



attempts, suspicious activities, or unauthorized access using sample logs. The system should visualize detected threats and generate alerts.

### **Mini Project 3: E-Payment Comparison and Analysis Tool**

**Problem Statement:** Develop a comparison tool using Python/C++, HTML/CSS that allows users to compare digital payment methods such as UPI, Net Banking and Credit Cards based on transaction speed, security, charges, and availability.

### **Mini Project 4: E-Commerce Startup Business Model Planner**

**Problem Statement:** Develop a simple platform or decision-support system using Python/ C++/ HTML/CSS that helps users select an appropriate E-Commerce business model (marketplace, subscription, affiliate, etc.) based on business requirements and goals.

### **Textbooks:**

1. Kenneth C. Laudon and Carol Guercio Traver, E-Commerce: Business, Technology, Society, 18<sup>th</sup> edition, 2023, Pearson Education, ISBN 978-1292449722.
2. Gary P. Schneider, E-Commerce Basics: Technology Foundations and E-Business Applications, 1<sup>st</sup> edition, 2013, Pearson Education, ISBN 978-0201748406.

### **Reference Books:**

1. Henry Chan and Raymond Lee, E-Commerce Marketing: Strategies for Engaging in E-Business, 1<sup>st</sup> edition, 2001, Wiley, ISBN 978-0471493037.
2. Russell S. Dunkle, E-Commerce Security: Risk Management and Control, 2008, Wiley, ISBN 978-0072292893.
3. Peter Fingar, Harsha Kumar, and Tarun Sharma, Enterprise E-Commerce, 1<sup>st</sup> ed, 2000, Meghan-Kiffer Press, ISBN 978-0929652115.

### **Website Links/ Online Resources**

1. **E-Business: By Prof. Mamata Jenamani, IIT Kharagpur**  
[https://onlinecourses.nptel.ac.in/noc19\\_mg54/preview](https://onlinecourses.nptel.ac.in/noc19_mg54/preview)
2. **E-commerce Technologies: G. Selva Jeba, Madurai Kamaraj University, Tamilnadu**  
[https://swayam.gov.in/nd2\\_cec19\\_cm01/preview](https://swayam.gov.in/nd2_cec19_cm01/preview)
3. **RBI Digital Payment Awareness Portal: Reserve Bank of India (RBI):**  
<https://www.rbi.org.in/commonman/English/Scripts/rbikehtahai.aspx>
4. **Miniproject: Smart India Hackathon: Retail & E-Commerce (SIH 2024)**  
<https://sih.gov.in/sih2024PS>
5. **Miniproject: Java Spring Boot Hackathon - E-Commerce Problem Statements**  
<https://www.scribd.com/document/852991306/Hackathon-Level-1-Problem-Statement>

**6. Miniproject: SIH Full Stack Problem Statements (Past Editions)**<https://www.scribd.com/document/930631184/SIH-Past-Problems-FullStack>

| Strength of CO-PO-PSO Mapping |     |      |     |     |     |     |     |     |     |      |      |      |      |      |
|-------------------------------|-----|------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO                            | PO1 | PO2  | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1                           | 2   | 2    | 1   | -   | -   | -   | -   | -   | -   | -    | 1    | 2    | 1    | -    |
| CO2                           | 2   | 3    | 2   | 1   | 2   | -   | -   | -   | -   | -    | 2    | 3    | 2    | 1    |
| CO3                           | 2   | 3    | 3   | 2   | 2   | -   | -   | -   | 2   | 2    | 2    | 3    | 2    | 1    |
| CO4                           | 2   | 3    | 2   | 3   | 2   | -   | -   | -   | -   | -    | 2    | 3    | 2    | 2    |
| Avg                           | 2   | 2.75 | 2   | 2   | 2   | -   | -   | -   | 2   | 2    | 1.75 | 2.75 | 1.75 | 1.33 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

| Assessment Pattern |     |     |     |     |
|--------------------|-----|-----|-----|-----|
| BT Level           | CCE |     |     |     |
|                    | CO1 | CO2 | CO3 | CO4 |
|                    | 6   | 6   | 6   | 7   |
| L1                 | —   | —   | —   | —   |
| L2                 | √   | √   | —   | —   |
| L3                 | —   | —   | √   | —   |
| L4                 | —   | —   | —   | √   |
| L5                 | —   | —   | —   | —   |
| L6                 | —   | —   | —   | —   |

| BT Level | CCE based on ARCV |       |       |       |       |       |       |       |       |         |
|----------|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|---------|
|          | Exp 1             | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10  |
| CO       | CO1               | CO2   | CO2   | CO2   | CO2   | CO2   | CO4   | CO4   | CO3   | CO2,3,4 |
| L1       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -       |
| L2       | √                 | √     | √     | √     | √     | √     | -     | -     | -     | √       |
| L3       | -                 | -     | -     | -     | -     | -     | -     | -     | √     | √       |
| L4       | -                 | -     | -     | -     | -     | -     | √     | √     | -     | √       |
| L5       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -       |
| L6       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -       |

**This course serves as a prerequisite for maps with the following future courses:**

- Web Technology and Web Application Development
- Data Analytics and Business Intelligence
- Information Security and Cyber Security
- Cloud Computing
- Entrepreneurship and Startup Development



### **Job Mapping:**

#### **Job/Future opportunities that one can get after learning this course:**

- Digital Marketing Executive
- E-Commerce Executive
- Web Application Developer
- E-Commerce Application Developer
- Digital Business Analyst
- SEO: Search Engine Optimization Analyst
- SEM: Search Engine Marketing Analyst
- Entrepreneur / Online Startup Founder



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                           |          |        |                    |                |               |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|----------|--------|--------------------|----------------|---------------|-----|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | S. Y. B. Tech: IT                                                         |          |        | Semester:          | III            |               |     |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Universal Human Values and Ethics                                         |          |        | Course Code:       | R25-IT-VEC-207 |               |     |
| Teaching Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                           |          |        | Examination Scheme |                |               |     |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Practical                                                                 | Tutorial | Credit | CCE                | ESE            | TW            | PR  |
| 02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | —                                                                         | --       | 02     | 50                 | --             | —             | —   |
| <b>Course Description</b><br>The course Universal Human Values & Ethics introduces engineering students to fundamental human values, ethical responsibilities, and professional behaviour required in modern workplaces. The course emphasizes honesty, integrity, empathy, social responsibility, and ethical decision making. It also focuses on professional communication, workplace etiquette, teamwork, leadership skills, and personality development required for successful careers in engineering and IT industries. |                                                                           |          |        |                    |                |               |     |
| <b>Course Relevance:</b><br>In the modern technological world, engineers must possess strong ethical values and professional conduct along with technical knowledge. This course helps students understand ethical responsibilities in engineering practice, professional workplace behaviour, effective communication, teamwork, and leadership qualities.                                                                                                                                                                    |                                                                           |          |        |                    |                |               |     |
| <b>Prerequisite:</b> <ul style="list-style-type: none"><li>Awareness of personal discipline, social behaviour and moral understanding</li><li>Ability to observe and reflect on human behaviour, society and environment</li></ul>                                                                                                                                                                                                                                                                                             |                                                                           |          |        |                    |                |               |     |
| <b>Bridge Content:</b> <ul style="list-style-type: none"><li>Communication, teamwork and social responsibility.</li><li>Self-development and professional conduct.</li></ul>                                                                                                                                                                                                                                                                                                                                                   |                                                                           |          |        |                    |                |               |     |
| <b>Course Objectives:</b> <ol style="list-style-type: none"><li>Understand the meaning and definition of human values</li><li>Understand the concept of harmony in nature through interconnectedness and mutual fulfillment</li><li>Use the characteristics and sources of ethics to analyze behavior in personal and professional contexts</li><li>Use codes of ethics and professional conduct in guiding behavior in real-life professional situations</li></ol>                                                            |                                                                           |          |        |                    |                |               |     |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                           |          |        |                    |                |               |     |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Course Outcome                                                            |          |        |                    |                | Bloom's Level |     |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | DESCRIBE the importance and characteristics of human values               |          |        |                    |                | 2             |     |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | EXPLAIN the interconnectedness and mutual fulfilment in nature            |          |        |                    |                | 2             |     |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | APPLY the sources of ethics to guide personal and professional behaviour. |          |        |                    |                | 3             |     |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | APPLY professional responsibilities towards society                       |          |        |                    |                | 3             |     |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                           |          |        |                    |                |               |     |
| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Introduction to Value Education and Harmony in the Human Being            |          |        |                    |                | 7 Hrs.        | CO1 |
| Meaning and definition of human values, Importance of human values in life, Characteristics of human values, Types of values: personal, social, moral, professional, Core human values: honesty, integrity, respect, responsibility, empathy, Role of values in personal development, Role of values in society and                                                                                                                                                                                                            |                                                                           |          |        |                    |                |               |     |



nation building, Value-based decision making, Importance of ethical behavior in daily life. Role of Value Education in Modern Technological Society, Understanding impact of Lifestyle on Mental and Physical Well-being, Relationship Between Thoughts, Behavior, and Happiness, Role of Meditation, Yoga, and Mindfulness in Human Harmony

**Exemplars/Case studies/Practical Applications and usage:**

**Activity: Gratitude and Respect Campaign:**

1. Conduct a “Respect Parents, Teachers, and Workers” awareness activity inside campus.
2. Students interview security guards, cleaners, drivers, or support staff and document their contributions.
3. Presenting prepared video/report highlighting dignity of labour and gratitude.

|               |                                      |               |            |
|---------------|--------------------------------------|---------------|------------|
| <b>Unit 2</b> | <b>Harmony in family and society</b> | <b>8 Hrs.</b> | <b>CO2</b> |
|---------------|--------------------------------------|---------------|------------|

Understanding Harmony in Nature – Interconnectedness and Mutual Fulfillment Holistic Perception of Harmony: Existence as Co- existence Natural Acceptance and Self-regulation as a Way of Life cyclicity in Nature and Responsibility of Human being Implications of Imbalance in Nature: Environmental and Societal Consequences. Compassion, and Emotional Intelligence promoting social harmony, Role of Family in Character Building and Ethical Development, Resolve interpersonal and social conflicts ethically for peaceful co-existence, Importance of Cooperation and Teamwork in Society

**Exemplars/Case studies/Practical Applications and usage:**

**Activity: Visit/Survey of Old Age Home / Orphanage /Deaf-Hard of Hearing School**

1. Visit/Survey of Old Age Home / Orphanage /Deaf-Hard of Hearing School and spend time interacting with senior citizens/ children.
2. Conduct activities like digital literacy support, games, health-awareness talks, or cultural programs.
3. Presenting prepared video/report on emotional bonding, respect for elders, and social care.

|               |                                        |               |            |
|---------------|----------------------------------------|---------------|------------|
| <b>Unit 3</b> | <b>Harmony in nature and existence</b> | <b>7 Hrs.</b> | <b>CO3</b> |
|---------------|----------------------------------------|---------------|------------|

Understanding Harmony in Nature- Interconnectedness and Mutual Fulfilment, Holistic Perception of Harmony: Existence as Co-existence, Natural Acceptance and Self-regulation as a Way of Life, Cyclicity in Nature and Responsibility of Human Being, Implications of Imbalance in Nature: Environmental and Societal Consequences, Sustainable Development and Responsible Consumption: Balancing technological progress with environmental protection, Environmental Ethics and Ecological Responsibility, Climate Change and Human Responsibility, Green Technologies and Eco-friendly Innovation for environmental protection.

**Exemplars/Case studies/Practical Applications and usage:**

**Activity: Visit/Survey of Ideal Village Study like Hivarebazar, Ralegansidhi**

1. Visit/survey an ideal village or smart village.
2. Study cleanliness, water management, renewable energy usage, education system, digital services, or waste management practices.
3. Presenting prepared video/report with observations and suggestions for improvement.

|               |                                                      |               |            |
|---------------|------------------------------------------------------|---------------|------------|
| <b>Unit 4</b> | <b>Professional ethics and application of values</b> | <b>8 Hrs.</b> | <b>CO4</b> |
|---------------|------------------------------------------------------|---------------|------------|



Competence in Professional Ethics: Code of Ethics for Engineers and IT Professionals, Workplace Ethics and Professional Behavior, Ability to utilize values in decision-making, Vision for a Value-Based Society, Corporate Social Responsibility (CSR) and Sustainable Business Practices, Integration of Human Values with Technical Education, Role of Human Values in Entrepreneurship and Startups Impact of Ethical values in the IT Sector

**Exemplars/Case studies/Practical Applications and usage:**

**Activity: Professional Ethical Case Study in IT Industry**

1. Visit/Survey of IT industry ethics in work culture, data privacy, cybercrime, Software piracy, AI misuse, plagiarism, or hacking.
2. Analyze ethical issues and suggest professional ethical solutions.
3. Submitting video/report of debate/group discussions arranged based on findings of above activity

**Textbooks:**

1. Colleen Murphy, Paolo Gardoni, Hassan Bashir, Charles E. Harris, Jr., Eyad Masad, Engineering Ethics for a Globalized World, 1st Edition, 2015, Springer, ISBN: 978-3319182605
2. R. S. Naagarazan, Professional Ethics and Human Values, 3rd Edition, 2022, New Age International, ISBN: 978-8122479278
3. R. S. Naagarazan, “A Textbook on Professional Ethics and Human Values”, 2nd Edition, 2006, New Age International Publishers, ISBN: 978-8122416266
4. A. Alavudeen, R. Kalil Rahman and M. Jayakumaran, Professional Ethics and Human Values, 1st Edition, 2012, Laxmi Publications, ISBN-13: 978-9380386117
5. M. Govindarajan, S. Natarajan, V. S. Senthil Kumar, Professional Ethics and Human Values, 2020 Edition, PHI Learning Pvt. Ltd., ISBN: 9788120348165.
6. A. N. Tripathi, Human Values, 3rd Edition, 2020, New Age International Publishers, ISBN: 9788122425895

**Reference Books:**

1. Charles E. Harris Jr.; Michael S. Pritchard; Michael J. Rabins, Engineering Ethics, 6th Edition, 2019, Cengage Learning, ISBN: 9781337554503
2. Subrata Das, Ethics and Human Values in Engineering Practices, 1st Edition, 2022, Woodhead Publishing India, ISBN: 9788195404834
3. Heinz Luegenbiehl; Rockwell Clancy, Global Engineering Ethics, 1st Edition, 2017, Elsevier, ISBN: 9780128112182
4. Dr. Ritu Soryan, Universal Human Values and Professional Ethics, 1<sup>st</sup> Edition, 2022, S.K. Kataria & Sons, ISBN: 9789350147467

**Website Links/ Online Resources**



- 1. Exploring Human Values: Visions of Happiness and Perfect Society: Prof. A.K. Sharma**  
IIT Kanpur, <https://nptel.ac.in/courses/109104068>
- 2. Moral Thinking: An Introduction to Values and Ethics: By Prof. Vineet Sahu, IIT Kanpur**  
[https://onlinecourses.nptel.ac.in/noc24\\_hs169/preview](https://onlinecourses.nptel.ac.in/noc24_hs169/preview)

**Strength of CO-PO-PSO Mapping**

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 2   | 3   | 2   | 3   | 2   | 1   | 1   | 1   | -    | 2    | 3    | 2    | 3    |
| CO2  | 3   | 2   | 2   | 2   | 3   | 2   | 2   | 1   | 1   | -    | 2    | 3    | 2    | 2    |
| CO3  | 3   | 2   | 2   | 2   | 2   | 2   | 1   | 2   | 1   | -    | 2    | 2    | 2    | 2    |
| CO4  | 3   | 2   | 2   | 2   | 2   | 2   | 2   | 1   | 1   | 1    | 2    | 2    | 2    | 2    |
| Avg. | 2.8 | 2   | 2.2 | 2   | 2.4 | 2   | 1.4 | 1   | 1   | 1    | 2    | 2.4  | 2    | 2.2  |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Assessment Pattern**

| BT Level | CCE |     |     |     |
|----------|-----|-----|-----|-----|
|          | CO1 | CO2 | CO3 | CO4 |
|          | 12  | 13  | 12  | 13  |
| L1       | —   | —   | —   | —   |
| L2       | √   | √   | —   | —   |
| L3       | —   | —   | √   | √   |
| L4       | —   | —   | —   | —   |
| L5       | —   | —   | —   | —   |
| L6       | —   | —   | —   | —   |

**This course serves as a prerequisite for maps with the following future courses:**

- Professional Ethics and Engineering Ethics
- Soft Skills, Communication Skills, and Personality Development
- Entrepreneurship Development and Innovation
- Project-Based Learning and Major Project Development
- Industrial Training / Internship / Placement Preparation
- Leadership and Management Skill Development courses

**Job Mapping:**

**Job/Future opportunities that one can get after learning this course:**

- IT Professional/Software Engineer
- System Analyst / Business Analyst
- Startup Founder / Entrepreneur
- HR Executive / Training and Development Associate



- Internship opportunities in IT
- Government and Public sector roles



|                        |                            |                     |                       |
|------------------------|----------------------------|---------------------|-----------------------|
| <b>Program:</b>        | <b>S. Y. B. Tech</b>       | <b>Semester:</b>    | <b>III</b>            |
| <b>Course:</b>         | <b>Data Structures Lab</b> | <b>Course Code:</b> | <b>R25-IT-PCC-208</b> |
| <b>Teaching Scheme</b> |                            |                     |                       |
| <b>Lecture</b>         | <b>Practical</b>           | <b>Tutorial</b>     | <b>Credit</b>         |
| --                     | 02                         | --                  | 01                    |

**Examination Scheme**

|            |            |           |           |
|------------|------------|-----------|-----------|
| <b>CCE</b> | <b>ESE</b> | <b>TW</b> | <b>PR</b> |
| --         | --         | 25        | 25        |

**Course Description:**

This laboratory course provides hands-on experience in implementing fundamental data structures and algorithms using programming languages such as C++ and Python. Students will develop practical skills in designing, coding, and analyzing various data structures including arrays, linked lists, stacks, queues, trees, graphs, and hashing techniques. The course also covers searching and sorting algorithms, recursion, and algorithm efficiency. Through problem-solving and real-world applications, students will understand the trade-offs between different data structures and algorithms, and learn to select appropriate techniques for efficient data handling and processing. This lab strengthens logical thinking, programming proficiency, and the ability to apply theoretical concepts to practical scenarios.

**Course Relevance:**

This course plays a vital role in building the foundation required for efficient software development. It enables students to translate theoretical concepts of data structures and algorithms into practical implementations, which is essential for solving real-world computational problems. The knowledge gained in this lab is widely applicable in areas such as system design, database management, networking, artificial intelligence, and software engineering. It also strengthens problem-solving ability, improves coding efficiency, and prepares students for technical interviews and industry-level programming challenges.

**Prerequisite:**

Basic programming knowledge (C/C++ or Python) and fundamental problem-solving skills.

**Bridge Content**

Revision of basic programming concepts, arrays, pointers, and simple problem-solving techniques required for understanding data structures.

**Course Objectives:**

1. To understand and implement fundamental data structures such as arrays, stacks, queues, trees, graphs, and hashing.
2. To develop problem-solving skills using appropriate searching and sorting algorithms.
3. To analyze and compare the performance of different algorithms and data structures.
4. To apply suitable data structures for solving real-world and computational problems.
5. To enhance programming proficiency and logical thinking through practical implementation.

**Course Outcomes:** After learning the course, students will be able to

| <b>CO</b> | <b>Course Outcome</b>                                                                                 | <b>Bloom's Level</b> |
|-----------|-------------------------------------------------------------------------------------------------------|----------------------|
| CO1       | <b>APPLY</b> searching and sorting techniques to organize and retrieve data efficiently.              | <b>3</b>             |
| CO2       | <b>IMPLEMENT</b> linear data structures such as stacks and queues for solving computational problems. | <b>3</b>             |



|     |                                                                                                     |          |
|-----|-----------------------------------------------------------------------------------------------------|----------|
| CO3 | <b>APPLY</b> non-linear data structures like trees and graphs for complex problem-solving.          | <b>3</b> |
| CO4 | <b>IMPLEMENT</b> advanced data structures such as Binary Search Trees and hashing techniques.       | <b>3</b> |
| CO5 | <b>ANALYZE</b> algorithm efficiency and select appropriate data structures for optimized solutions. | <b>4</b> |

| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                    |              |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------------|------------|
| <b>List of Practical:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                    |              |            |
| <b>Experiment No. 1 :</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Templates/Containers (C++)</b>  | <b>2 hrs</b> | <b>CO1</b> |
| <p><b>Objective:</b><br/>To understand the use of STL container operations for efficient data handling.</p> <p><b>Associated Task:</b><br/>The college Information Management System (MIS) maintains records of students from different departments, including Roll Number, Name, and SGPA. Since the number and type of records may vary, the system should be flexible and reusable. Develop a program in C++ using Templates and STL Containers to store and manage student records efficiently. The program should use templates for generic operations and STL containers such as vector, list, or map for storing records. The system should support operations like insertion, deletion, searching, sorting, and displaying student information.</p> <p><b>Exemplars and Utility:</b><br/>The college Information Management System (MIS) stores and manages student details from different departments using dynamic containers. This MIS will be used in educational institutions, databases, and software applications for flexible record management and efficient data handling.</p>                                                                                                                                                                     |                                    |              |            |
| <b>Experiment No.2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Searching and Sorting (C++)</b> | <b>2 hrs</b> | <b>CO2</b> |
| <p><b>Objective:</b><br/>To develop the ability to implement, analyze, and compare different searching and sorting algorithms, and to select efficient techniques based on problem requirements and data characteristics.</p> <p><b>Associated Task :</b><br/>A college library management system maintains records of books containing Book ID, Book Title, Author Name, and Availability Status. The librarian needs a system to search books efficiently and organize the catalog in a proper order. Design and implement a program using an array of structures to perform the following operations:</p> <ol style="list-style-type: none"> <li>1. Implement Linear Search and Binary Search to find a book record using Book ID.</li> <li>2. Arrange the catalog of books in ascending order of Book ID using Bubble Sort.</li> <li>3. Arrange the catalog alphabetically according to Book Title using Insertion Sort.</li> </ol> <p><b>Exemplars and Utility:</b><br/>Library management systems commonly use searching and sorting techniques to retrieve and organize book records efficiently. Similar algorithms are widely used in applications such as e-commerce platforms for product searches, banking systems for record management, and search</p> |                                    |              |            |



engines for fast data organization and retrieval.

|                        |                    |              |            |
|------------------------|--------------------|--------------|------------|
| <b>Experiment No.3</b> | <b>Stack (C++)</b> | <b>4 hrs</b> | <b>CO3</b> |
|------------------------|--------------------|--------------|------------|

**Objective:**

To design and implement a Stack Abstract Data Type (ADT) using a singly linked list understanding dynamic memory allocation and the practical use of stack operations.

**Associated Task :**

A scientific calculator application processes arithmetic expressions entered by users. To perform calculations efficiently, implement Stack as an Abstract Data Type (ADT) using a singly linked list in C++. It accepts arithmetic expressions from users in infix form. To evaluate expressions efficiently, the calculator must convert infix expressions into postfix expressions and evaluation of postfix expressions using Stack operations.

**Exemplars and Utility:**

Scientific calculator applications use stacks to convert infix expressions into postfix form and to evaluate expressions efficiently. Similar stack-based techniques are widely used in expression evaluation, compiler design, browser history management, undo/redo operations, and function call management in operating systems and programming languages.

|                        |                             |              |            |
|------------------------|-----------------------------|--------------|------------|
| <b>Experiment No.4</b> | <b>Circular Queue (C++)</b> | <b>2 hrs</b> | <b>CO3</b> |
|------------------------|-----------------------------|--------------|------------|

**Objective:**

To implement a queue using array and linked list and perform basic operations such as enqueue, dequeue, and display.

**Associated Task :**

Implement a railway reservation system in C++ program to manage the railway passenger waiting list using a Circular Queue implemented with Linked List. The program should allow adding passengers when seats are full and removing passengers when tickets get confirmed following FIFO order. Implement operations such as insertion, deletion, display, and queue status checking (full/empty). Store Passenger ID and Passenger Name, and display appropriate overflow and underflow messages.

**Exemplars and Utility:**

The railway reservation systems use queue operations to manage passenger waiting lists efficiently. Similar queue-based techniques are widely used in CPU scheduling, printer spooling systems, customer service systems, traffic management systems, and ticket reservation applications.

|                        |                      |              |            |
|------------------------|----------------------|--------------|------------|
| <b>Experiment No.5</b> | <b>Tree (Python)</b> | <b>2 hrs</b> | <b>CO3</b> |
|------------------------|----------------------|--------------|------------|

**Objective:**

To understand tree-based representation of expressions and develop skills in implementing and traversing binary trees using both recursive and iterative approaches.

**Associated Task :**



A mathematical expression evaluation system is used in a calculator application to process arithmetic expressions efficiently. Develop a program in Python to construct an Expression Tree from a given arithmetic expression and perform different tree traversals such as In-order, Pre-order, and post-order to display the expression in different notations. The system should also support evaluation of the expression using the constructed Expression Tree.

#### Exemplars and Utility:

The calculator applications use expression trees to evaluate mathematical expressions efficiently. Similar tree-based techniques are widely used in compiler design, expression evaluation, XML/HTML document processing, file systems, and artificial intelligence applications.

#### Experiment No.6

#### Binary Search Trees (Python)

2 hrs

CO4

#### Objective:

To understand and implement Binary Search Tree operations and explore tree properties through various manipulations and traversals.

#### Associated Task :

A hospital management system maintains patient records using Patient IDs for quick access and organized storage. To efficiently manage the records, implement a Binary Search Tree (BST) in python and perform the following operations:

- i) insertion of new patient records,      ii) deletion of records,
- iii) searching a patient by ID,              iv) displaying records using tree traversals,
- v) finding the depth of the tree,              vi) creating the mirror image of the tree,
- vii) creating a copy of the tree,              viii) displaying all leaf nodes, and
- ix) displaying the tree level wise.

#### Exemplars and Utility:

The hospital management systems use Binary Search Trees to store patient records for efficient searching, retrieval and organization of data. Similar BST-based techniques are widely used in database indexing, file organization systems, dictionary implementations, and hierarchical data storage applications.

#### Experiment No.7

#### Graph: Minimum Spanning Tree (Python)

4 hrs

CO4

#### Objective:

To model a real-world problem using graph representation and apply minimum spanning tree algorithms to determine the optimal path with minimum cost.

#### Associated Task:

A city municipal corporation is planning to install internet cable connections between different offices located across the city. The cost of connecting each pair of offices is different depending on the distance and installation expense. To minimize the total installation cost while ensuring that all offices remain connected, implement Prim's Algorithm and Kruskal's Algorithm to find the Minimum Spanning Tree (MST) of the network.

#### Exemplars and Utility:



The municipal corporations use Minimum Spanning Tree algorithms to design cable networks with minimum installation cost while maintaining connectivity among offices. Similar graph-based techniques are widely used in communication networks, transportation systems, electrical grid design, road planning, and network routing applications.

**Experiment No. 8****Hashing (Python)****2 hrs****CO5****Objective:**

To implement a perfect hashing technique for storing a set of keys without collision.

**Associated Task:**

A banking system stores customer account details using unique Account Numbers. To provide fast access to customer records, develop a Python program that implements hashing techniques. Use hashing functions for storing records and handle collisions using chaining, linear probing, and quadratic probing methods. The system should support insertion, searching, deletion, and display of account records.

**Exemplars and Utility:**

The banking systems use hashing techniques to store and retrieve customer account information efficiently using unique account numbers as keys. Similar hashing methods are widely used in password authentication systems, database indexing, cache memory management, symbol tables.

**Experiment No. 9****Heap Sort (Python)****2 hrs****CO5****Objective:**

To understand and implement the Heap Sort algorithm by constructing a Max Heap or Min Heap, and to use it for efficiently sorting a given set of values while analyzing its performance in terms of time complexity

**Associated Task:**

An online shopping company maintains records of product prices that need to be displayed in sorted order for analysis and reporting. To efficiently organize the prices, implement Heap Sort using Max Heap or Min Heap to sort the given set of product prices in ascending or descending order.

**Exemplars and Utility:**

The online shopping systems use Heap Sort to organize product prices for analysis and reporting. Similar heap-based techniques are widely used in priority scheduling, operating systems, database systems, event simulation, and large-scale data processing applications.

**Experiment No. 10****Mini Project: Using C++/python****6 hrs****CO5**

Following are the sample statements for miniproject but not limited to:

**Mini Project 1: Cinema Seat Booking System (Array)**

**Objective:** To design and implement a cinema hall seat booking system using arrays in C++/Python that efficiently manages seat reservations.



**Associated Task:** Develop a program that represents the cinema hall seating arrangement using a 2D array. Each seat can be marked as booked or available. The system should support the following operations:

- Mark Seat Booked - Reserve a seat by updating its status.
- Cancel Booking - Free up a seat when a booking is canceled.
- Search Seat - Check if a particular seat number is booked or available.

### Mini Project 2: Music Playlist Manager (Linked List)

**Objective:** To design and implement a music playlist application using a linked list in C++/Python that demonstrates dynamic memory allocation and traversal operations.

**Associated Task:** Develop a program that manages a playlist of songs where each song is represented as a node in a linked list. The system should support the following operations:

- Add Song - Insert a new song into the playlist.
- Delete Song - Remove a song from the playlist by title or position.
- Search Song - Find a song in the playlist by its title.

### Mini Project 3: Undo/Redo Text Editor (Stack)

**Objective:** To design and implement a simple text editor in C++/Python using stack operations that supports typing, deleting, and undo/redo functionality.

**Associated Task:** Develop a program that simulates a basic text editor where each user action (typing or deleting text) is stored in a stack. The system should support the following operations:

- Typing Operation - Add new text to the editor and push the action onto the stack
- Delete Operation - Remove text and record the action for possible undo.
- Undo Operation - Reverse the last action by popping from the stack.
- Redo Operation - Reapply an undone action by maintaining a secondary stack
- Display Text - Show the current state of the text after each operation.

### Mini Project 4: File-Based Inventory System

**Objective:** To design and implement an inventory management system in C++/Python using file handling that ensures persistent storage of product records.

**Associated Task:** Develop a program that maintains product details (Product ID, Name, Quantity, Price) in files. The system should support the following operations:

- Add Product - Insert new product details into the inventory file.
- Update Product - Modify existing product information such as quantity or price.
- Delete Product - Remove a product record from the file.
- Search Product - Retrieve product details using Product ID or Name.
- Display Inventory - Show all product records stored in the file.

### Textbooks:

1. Reema Thareja, Data Structures and Algorithms, 2025, Oxford University Press, ISBN: 9789367252673.
2. Michael T. Goodrich, Roberto Tamassia, David M. Mount, Data Structures and Algorithms



in C++, 2nd Edition, 2011, John Wiley & Sons, ISBN: 978-0-470-38327-8.

3. Narasimha Karumanchi, Data Structures and Algorithms Made Easy, 5th Edition, 2023, CareerMonk Publications, ISBN: 9788193245279.
4. Chandan Banerjee, Atanu Das, Data Structures and Algorithms in C and Python, 2023, Orient Blackswan, ISBN: 9788195400904.

#### Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 4th Edition, 2022, MIT Press, ISBN: 9780262046305.
2. Michael T. Goodrich, Roberto Tamassia, David M. Mount, Data Structures and Algorithms in C++, 2nd Edition, 2011, John Wiley & Sons, ISBN: 0470383275
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition, 2023, Pearson Education, ISBN: 9780132847377.
4. Steven S. Skiena, The Algorithm Design Manual, 3rd Edition, 2020, Springer, ISBN: 9783030542559.

#### Website Links/ Online Resources

1. **Data Structures and Algorithms Design:** Prof. Nitin Saxena, IIT Kanpur  
[https://onlinecourses.nptel.ac.in/noc25\\_cs81/preview](https://onlinecourses.nptel.ac.in/noc25_cs81/preview)
2. **Data Structures and Algorithms: By Prof. Naveen Garg, IIT Delhi**  
<https://nptel.ac.in/courses/106102064>
3. **Greedy Algorithm Tutorials**  
<https://www.wscubetech.com/resources/dsa/greedy-algorithms>
4. **Huffman Coding**  
<https://www.geeksforgeeks.org/dsa/huffman-coding-greedy-algo-3>
5. **Data Structures Virtual Lab – IIIT Hyderabad**  
<https://ds1-iiith.vlabs.ac.in>
6. **Mini-Project: Smart India Hackathon -Smart Automation & FinTech**  
<https://sih.gov.in/sih2024PS>
7. **Mini-Project: GeeksforGeeks-Top Hackathon Project Ideas 2025**  
<https://www.geeksforgeeks.org/blogs/project-ideas-for-hackathons/>
8. **Mini-Project: Hackathon Project Ideas 2026**  
<https://unstop.com/blog/hackathon-project-ideas>

#### Strength of CO-PO-PSO Mapping



| CO  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -    | -    | 2    | 2    | 2    |
| CO2 | 3   | 3   | 3   | 2   | 2   | -   | -   | -   | 2   | -    | -    | 3    | 2    | 2    |
| CO3 | 3   | 3   | 3   | 3   | 2   | -   | -   | -   | 2   | -    | -    | 3    | 3    | 2    |
| CO4 | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | 2   | -    | -    | 3    | 3    | 2    |
| CO5 | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | 2   | 2    | 2    | 3    | 3    | 2    |
| Avg | 3   | 3   | 2.8 | 2.6 | 2.4 | -   | -   | -   | 2   | 2    | 2    | 2.8  | 2.6  | 2    |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE based on ARCV |       |       |       |       |       |       |       |       |        |
|----------|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
|          | Exp 1             | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10 |
| CO       | CO1               | CO2   | CO3   | CO3   | CO3   | CO4   | CO4   | CO5   | CO5   | CO5    |
| L1       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |
| L2       |                   |       |       |       |       | -     | -     | -     | -     | -      |
| L3       | ✓                 | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | -     | -     | -      |
| L4       | -                 | -     | -     | -     | -     | -     | -     | ✓     | ✓     | ✓      |
| L5       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |
| L6       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |

**This course serves as a prerequisite for / maps with the following future courses:**

- Design and Analysis of Algorithms,
- Database Management Systems,
- Operating Systems,
- Computer Networks,
- Artificial Intelligence,
- Machine Learning,
- Compiler Design
- Advanced Data Structures.

### Job Mapping:

**Job/Future opportunities that one can get after learning this course:**

- Software Developer / Engineer
- Data Analyst / Data Engineer
- System Programmer
- Machine Learning / AI Engineer
- Backend Developer
- Competitive Programmer
- Coding Expert



|                 |                              |          |        |                    |              |                |    |
|-----------------|------------------------------|----------|--------|--------------------|--------------|----------------|----|
| Program:        | S. Y. B. Tech                |          |        |                    | Semester:    | III            |    |
| Course:         | Computer Graphics Laboratory |          |        |                    | Course Code: | R25-IT-PCC-209 |    |
| Teaching Scheme |                              |          |        | Examination Scheme |              |                |    |
| Lecture         | Practical                    | Tutorial | Credit | CCE                | ESE          | TW             | PR |
| --              | 02                           | --       | 01     | --                 | --           | 25             | 25 |

**Course Description**

The Computer Graphics Lab course is designed to provide students with practical exposure to the fundamental concepts and techniques of computer graphics. The course covers implementation of various graphics algorithms such as line and circle drawing, polygon filling, clipping, transformations, curve generation, fractal patterns, and animation techniques using object-oriented programming concepts. Students gain hands-on experience with graphics libraries like OpenGL, Java 2D, or JavaFX and learn the mathematical foundations behind graphical transformations and rendering. The course also emphasizes creativity and application development through interactive graphics programs and animation mini-projects using open-source tools.

**Course Relevance:**

Computer Graphics Lab is highly relevant in the modern computing world as graphical interfaces, animation, gaming, multimedia systems, virtual reality, and simulation technologies are widely used across industries. This course helps students develop problem-solving skills and strengthens their understanding of graphics programming, object-oriented design, and mathematical modeling. The practical implementation of graphics algorithms and animation principles prepares learners for advanced domains such as game development, augmented and virtual reality, visualization systems, CAD/CAM applications, and multimedia software development. It also enhances creativity, programming proficiency, and industry-oriented software.

**Prerequisite:**

Basic Geometry, Trigonometry, Vectors and Matrices, Data Structures and Algorithms.

**Bridge Content**

Basic understanding of C++.

**Course Objectives:**

1. **Describe and explain** the fundamental concepts of Computer Graphics and the OpenGL programming environment.
2. **Apply** the basic principles and techniques of Computer Graphics for graphical object creation and visualization.
3. **Implement and analyze** various algorithms used for generating, rendering, and manipulating graphical objects.
4. **Apply** mathematical concepts such as vectors, matrices, and transformations in performing graphical operations and object transformations.
5. **Design and develop** simple animations using appropriate animation methods, principles, and techniques.
- 6.

**Course Outcomes:** After learning the course, students will be able to

| CO  | Course Outcome                                                     | Bloom's Level |
|-----|--------------------------------------------------------------------|---------------|
| CO1 | IMPLEMENT line and circle drawing algorithms to generate graphical | 3             |



|     |                                                                                                                                                            |   |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|     | objects.                                                                                                                                                   |   |
| CO2 | <b>DEMONSTRATE</b> polygon filling methods for graphical object rendering.                                                                                 | 3 |
| CO3 | <b>EXECUTE</b> 2D transformation and polygon clipping algorithms for graphical objects.                                                                    | 3 |
| CO4 | <b>EXECUTE</b> and implement fractal pattern generation using the Koch Curve algorithm                                                                     | 3 |
| CO5 | <b>DEMONSTRATE</b> curve generation algorithms for graphical object creation and animation of graphical objects using animation principles and techniques. | 3 |

### Guidelines for Laboratory Conduction

- All experiments should be implemented in C++ with OpenGL libraries.
- Experiment-1 (week-1) should cover all the basic functions of openGL to get students familiar with Graphics Environment. So, this experiment is not included in Practical Exam.
- The different objects/shapes/patterns should be drawn for implementation of drawing algorithm.
- All Experiments should explore the conceptual understanding of students.

### List of Practical:

|                        |                                       |              |             |
|------------------------|---------------------------------------|--------------|-------------|
| <b>Experiment No.1</b> | <b>Install and explore the OpenGL</b> | <b>2 Hrs</b> | <b>CO 1</b> |
|------------------------|---------------------------------------|--------------|-------------|

#### Objective:

To install and explore the basic features and working environment of OpenGL for computer graphics programming.

#### Associated Tasks:

1. Install OpenGL libraries and required development tools.
2. Configure the compiler/IDE for OpenGL programming.
3. Create and execute a simple OpenGL program.
4. Explore basic graphics functions such as drawing points, lines, and shapes.

#### Exemplars and Utility:

The successful execution of a simple OpenGL program demonstrated the drawing of basic geometric objects such as points, lines and shapes. It helps students to understand the fundamentals of graphics programming, rendering concepts and the development of interactive graphical applications.

|                        |                                |              |             |
|------------------------|--------------------------------|--------------|-------------|
| <b>Experiment No.2</b> | <b>Line Drawing Algorithms</b> | <b>2 Hrs</b> | <b>CO 1</b> |
|------------------------|--------------------------------|--------------|-------------|

#### Objective:

To understand and implement DDA (Digital Differential Analyzer) and Bresenham's line drawing algorithms for generating straight lines in computer graphics and compare their working principles and efficiency. i) Simple Line ii) Dotted Line iii) Dashed Line

#### Associated Tasks:



1. Write a program to draw a line using the DDA line drawing algorithm.
2. Write a program to draw a line using Bresenham's line drawing algorithm.
3. Accept line end-point coordinates from the user.
4. Display the generated line graphically using a graphics library such as OpenGL/Java Graphics.

**Exemplars and Utility:**

The graphical display of simple, dotted and dashed lines using DDA and Bresenham's line drawing algorithms are demonstrated. It helps students understand raster graphics concepts, line generation techniques, algorithm efficiency, and the practical use of graphics libraries such as OpenGL for computer graphics applications.

|                        |                                 |              |             |
|------------------------|---------------------------------|--------------|-------------|
| <b>Experiment No.3</b> | <b>Circle Drawing Algorithm</b> | <b>2 Hrs</b> | <b>CO 1</b> |
|------------------------|---------------------------------|--------------|-------------|

**Objective:**

To implement the Midpoint Circle Drawing Algorithm for generating and displaying a circle efficiently using computer graphics principles.

**Associated Tasks:**

1. Write a program to implement the Midpoint Circle Drawing Algorithm.
2. Accept the center coordinates and radius of the circle as input from the user.
3. Calculate the circle points using the midpoint decision parameter.
4. Plot the symmetric points of the circle on the screen.
5. Display the complete circle using a suitable graphics library such as OpenGL or Java Graphics.

**Exemplars and Utility:**

The successful implementation and graphical display of a circle using the Midpoint Circle Drawing Algorithm are demonstrated. It helps students understand efficient rasterization techniques, symmetry properties of circles, midpoint decision parameter calculations and the practical application of computer graphics concepts using graphics libraries such as OpenGL or Java Graphics.

|                        |                                  |              |             |
|------------------------|----------------------------------|--------------|-------------|
| <b>Experiment No.4</b> | <b>Polygon Filling algorithm</b> | <b>2 Hrs</b> | <b>CO 2</b> |
|------------------------|----------------------------------|--------------|-------------|

**Objective:**

To implement Flood Fill and Boundary Fill algorithms for filling closed graphical objects with desired colors and to understand the working of region-filling techniques used in Computer Graphics.

**Associated Tasks:**

1. Draw a closed polygon or any enclosed graphical object using graphics functions.
2. Implement the Flood Fill algorithm to fill the selected region with a specified color.
3. Implement the Boundary Fill algorithm to fill the region until the boundary color is reached.
4. Compare the working of Flood Fill and Boundary Fill algorithms based on filling behavior and boundary conditions.

**Exemplars and Utility:**

The successful implementation and visualization of Flood Fill and Boundary Fill algorithms for region filling in graphical objects are demonstrated. These algorithms are used in image editing and paint systems, Object colouring in games, animation, Map colouring, GIS systems, GUI, icon designing applications, visualization systems

|                        |                                                 |              |             |
|------------------------|-------------------------------------------------|--------------|-------------|
| <b>Experiment No.5</b> | <b>Cohen–Sutherland Line Clipping Algorithm</b> | <b>2 Hrs</b> | <b>CO 3</b> |
|------------------------|-------------------------------------------------|--------------|-------------|

**Objective:**

To implement the Cohen–Sutherland Line Clipping Algorithm for clipping lines against a rectangular clipping window and to understand the concept of visible, invisible, and partially visible line segments in Computer Graphics.

**Associated Tasks:**

1. Create a rectangular clipping window on the screen.
2. Draw one or more-line segments with different positions relative to the clipping window.
3. Implement the Cohen–Sutherland line clipping algorithm using appropriate region codes.
4. Identify whether each line is completely visible, partially visible, or completely invisible.

**Exemplars and Utility:**

The successful creation and visualization of a rectangular clipping window are demonstrated through the implementation of the Cohen–Sutherland Line Clipping Algorithm using region codes for clipping operations. These algorithms are used in image editing, Video games, Graphical User Interface (GUI), digital maps Animations, simulation software

|                        |                                 |              |             |
|------------------------|---------------------------------|--------------|-------------|
| <b>Experiment No.6</b> | <b>Basic 2D transformations</b> | <b>2 Hrs</b> | <b>CO 3</b> |
|------------------------|---------------------------------|--------------|-------------|

**Objective:**

To implement and apply basic 2D transformations such as translation, rotation, and scaling on graphical objects.

**Associated Tasks:**

1. Create a 2D graphical object such as a triangle or rectangle.
2. Implement translation transformation on the object.
3. Implement rotation and scaling transformations using appropriate mathematical formulas.
4. Display the transformed object using a graphics library such as OpenGL or Java Graphics.

**Exemplars and Utility:**

The successful creation and transformation of 2D graphical objects such as triangles and rectangles using translation, rotation, and scaling operations are demonstrated. These algorithms are used in computer graphics, animation, CAD systems, gaming and GUI applications.

|                        |                                   |              |             |
|------------------------|-----------------------------------|--------------|-------------|
| <b>Experiment No.7</b> | <b>Fractal pattern generation</b> | <b>2 Hrs</b> | <b>CO 4</b> |
|------------------------|-----------------------------------|--------------|-------------|

**Objective:**

To implement fractal pattern generation using the Koch Curve algorithm and understand recursive graphics concepts.

**Associated Tasks:**

1. Study the concept and mathematical formation of the Koch Curve fractal.
2. Write a program to generate the Koch Curve using recursion.
3. Display the fractal pattern graphically using a suitable graphics library.
4. Analyze the effect of recursion depth on the complexity and appearance of the fractal.

**Exemplars and Utility:**

The successful implementation and graphical visualization of the Koch Curve fractal using recursive techniques are demonstrated. These methods are used in computer graphics, procedural modeling, animation, simulation and digital art applications.

|                        |                                         |              |             |
|------------------------|-----------------------------------------|--------------|-------------|
| <b>Experiment No.8</b> | <b>Interactive Graphics Application</b> | <b>2 Hrs</b> | <b>CO 5</b> |
|------------------------|-----------------------------------------|--------------|-------------|

**Objective:**

To design and develop an interactive graphics application demonstrating animation principles using object-oriented programming concepts.

**Associated Tasks:**

1. Create graphical objects and display them using a graphics library such as OpenGL or JavaFX.
2. Implement object movement and interaction using animation techniques.
3. Apply object-oriented concepts like classes, inheritance, and polymorphism in the application.
4. Develop user interaction features such as keyboard or mouse controls for animation handling.

**Exemplars and Utility:**

The successful design and development of an interactive graphics application are demonstrated. The development of applications such as a bouncing ball animation, moving car simulation, simple 2D game, GUI systems and real-time visualization softwares

|                        |                                                 |              |             |
|------------------------|-------------------------------------------------|--------------|-------------|
| <b>Experiment No.9</b> | <b>Virtual Reality Modeling Language (VRML)</b> | <b>2 Hrs</b> | <b>CO 5</b> |
|------------------------|-------------------------------------------------|--------------|-------------|

**Objective:**

To understand the basics of Virtual Reality Modeling Language and create simple 3D virtual objects and scenes.

**Associated Tasks:**

1. Study the structure and syntax of VRML files.
2. Create basic 3D objects such as cube, sphere, cone, and cylinder using VRML.
3. Apply colors, transformations, and viewpoints to the virtual scene.
4. Execute and visualize the VRML scene using a compatible VRML viewer/browser.

**Exemplars and Utility:**

The development of a simple interactive 3D virtual environment containing multiple VRML objects demonstrated. It helps students learn 3D scene creation and visualization techniques used in Virtual Reality applications.

|                             |                     |              |             |
|-----------------------------|---------------------|--------------|-------------|
| <b>Experiment<br/>No.10</b> | <b>Mini Project</b> | <b>6 Hrs</b> | <b>CO 5</b> |
|-----------------------------|---------------------|--------------|-------------|

Following are sample statements but not limited to:

**Mini project: 1: Growing Tree Animation:****Problem Statement:**

Create a short-animated scene using tools like Blender, OpenToonz, Pencil2D or other open-source animation software showing the gradual growth of a tree from a seed into a fully developed tree with moving leaves and environmental effects using Blender or any open-source animation software.

**Mini project: 2: Morphing Animation:**

**Problem Statement:** Design a smooth morphing animation using tools like Blender, OpenToonz, Pencil2D or other open-source animation software where one object or character transforms into another shape using key frame animation and transformation techniques.

**Mini project: 3: Bird Flying Animation:**

**Problem Statement:** Develop an animated scene using tools like Blender, OpenToonz, Pencil2D or other open-source animation software of a bird flying through the sky with realistic wing movement, background scenery and motion effects using 2D or 3D animation tools.

**Mini project: 4: Fish Swimming in Water Animation:**

**Problem Statement:** Create an underwater animation using tools like Blender, OpenToonz, Pencil2D or other open-source animation software showing a fish swimming naturally in water with bubble effects, water movement, and simple marine background elements.

**Textbooks:**

1. D. Hearn, M. Baker, “Computer Graphics – C Version”, Pearson Education, 4th Edition, 2011, ISBN:8178087944
2. Grigore C. Burdea, Philippe Coiffet, “Virtual Reality Technology”, 3rd Edition , 2024, Wiley India Edition, ISBN 812650789-6

**Reference Books:**

1. D. Rogers, “Procedural Elements for Computer Graphics”, 4nd Edition, 2011, Tata McGraw-Hill Publication, ISBN:0070473714.
2. J. Foley, V. Dam, S. Feiner, J. Hughes, “Computer Graphics Principles and Practice”, 4th Edition, 2013, Pearson Education, ISBN:8178080389.



3. “Computer Graphics: Principles & Practice in C” by James D. Foley, Andries van Dam, Steven K. Feiner, and John F. Hughes, 3rd Edition, 2013, ISBN: 9788131705056
4. “Computer Graphics Using OpenGL” by F. S. Hill Jr. Latest Edition: 3rd Edition, 2007, Pearson Education, ISBN: 9780131496705.

#### Website Links/ Online Resources

1. Introduction to Computer Graphics by David J. Eck  
<https://open.umn.edu/opentextbooks/textbooks/420>
2. Computer Graphics: Prof. Samit Bhattacharya, IIT Guwahati  
<https://nptel.ac.in/courses/106103224>
3. Introduction to Computer Graphics, Prof. Prem K Kalra, IIT Delhi  
<https://nptel.ac.in/courses/106102065>
4. Mini-projects: Intellothon-AI & Computer Vision Hackathon,  
<https://intellothon.devpost.com/>
5. Mini-projects: OpenCV Project Gallery  
<https://devpost.com/software/built-with/opencv>

#### CO-PO-PSO Mapping

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7  | PO8  | PO9  | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|
| CO1  | 3   | 3   | 3   | 2   | 2   | 1   | 2    | 1    | -    | 1    | 1    | 2    | 2    | 2    |
| CO2  | 3   | 3   | 3   | 2   | 2   | 2   | -    | -    | 2    | 2    | 2    | 2    | 2    | 3    |
| CO3  | 3   | 3   | 3   | 2   | 2   | 2   | -    | -    | -    | -    | 1    | 2    | 2    | 3    |
| CO4  | 2   | 3   | 1   | 2   | 1   | 2   | 1    | 2    | 1    | 1    | -    | 2    | 2    | 3    |
| CO5  | 2   | 3   | 1   | 2   | 1   | 2   | 1    | 2    | 1    | 1    | -    | 2    | 2    | 2    |
| Avg. | 2.6 | 3   | 2.2 | 2   | 1.6 | 1.8 | 1.33 | 1.66 | 1.33 | 1.25 | 1.34 | 2    | 2    | 2.66 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

#### Assessment Pattern

| BT Level | CCE based on ARCV |       |       |       |       |       |       |       |       |        |
|----------|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
|          | Exp 1             | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10 |
| CO       | CO1               | CO1   | CO1   | CO2   | CO3   | CO3   | CO4   | CO5   | CO5   | CO5    |
| L1       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |
| L2       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |
| L3       | ✓                 | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓      |
| L4       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |



|           |   |   |   |   |   |   |   |   |   |   |
|-----------|---|---|---|---|---|---|---|---|---|---|
| <b>L5</b> | - | - | - | - | - | - | - | - | - | - |
| <b>L6</b> | - | - | - | - | - | - | - | - | - | - |

**This course serves as a prerequisite for maps with the following future courses:**

- Advanced Computer Graphics
- Multimedia Systems
- Image Processing
- Computer Vision
- Animation and Visual Effects
- Virtual Reality and Augmented Reality
- Game Design and Development

**Job Mapping:**

**Job/Future opportunities that one can get after learning this course:**

- Computer Graphics Engineer
- Graphics Programmer
- Game Developer
- Animator (2D / 3D)
- Visual Effects (VFX) Artist
- Multimedia Designer
- UI/UX Designer
- Web Graphics Designer
- Image Processing Engineer
- Computer Vision Engineer
- AR/VR Developer
- Simulation and Modeling Engineer
- CAD/CAM Designer



|                        |                                     |                     |                       |
|------------------------|-------------------------------------|---------------------|-----------------------|
| <b>Program:</b>        | <b>S. Y. B. Tech. - I.T.</b>        | <b>Semester:</b>    | <b>III</b>            |
| <b>Course:</b>         | <b>Community Engagement Project</b> | <b>Course Code:</b> | <b>R25-IT-CEP-210</b> |
| <b>Teaching Scheme</b> |                                     |                     |                       |
| <b>Lecture</b>         | <b>Practical</b>                    | <b>Tutorial</b>     | <b>Credit</b>         |
| --                     | 04                                  | --                  | 02                    |

|                           |            |           |           |
|---------------------------|------------|-----------|-----------|
| <b>Examination Scheme</b> |            |           |           |
| <b>CCE</b>                | <b>ESE</b> | <b>TW</b> | <b>PR</b> |
| --                        | --         | 50        | -         |

**Course Description:**

- The Community Engagement Project course is a practice-oriented experiential learning course designed to bridge the gap between academic knowledge and real-world societal needs.
- It enables students to identify, analyze, and solve community-based problems using Information Technology/aligned area tools and methodologies.
- The students work in teams to engage with local communities, understand socio-economic and environmental challenges, and develop sustainable, technology-driven solutions.
- The course includes fieldwork, stakeholder interaction, domain-oriented survey, social responsibility, sustainable solution for real world problems beyond classroom learning.

**Course Relevance:**

- This course aligns with the vision of the National Education Policy 2020 by promoting experiential learning.
- It involves community engagement along with multidisciplinary problem-solving.
- It prepares students to become socially responsible engineers who can apply technical knowledge for societal development.
- It addresses community challenges such as pollution, waste management, water scarcity, climate change, energy transition, natural disasters, biodiversity loss, land degradation, sustainability, smart cities, healthcare, agriculture and digital transformation etc.
- It also enhances employability by developing practical skills, teamwork, leadership and innovation.

**Prerequisite:**

Students should have prior knowledge of

- Problem-solving methodologies
- Basic programming knowledge is essential

**Bridge Content**

- Introduction to community engagement, societal challenges and sustainable development concepts.
- Basics of problem identification, field survey, data collection, and project planning.
- Overview of relevant Engineering tools, technologies such as IoT, AI, and web/mobile development.



- Fundamentals of teamwork, stakeholder communication and technical documentation.

**Course Objective:**

After learning the course, students will be able to

1. To expose students to real-life societal, environmental, and community challenges
2. To develop social responsibility, ethics, and teamwork skills
3. To apply IT knowledge for solving community problems
4. To enhance problem-solving, communication, and leadership abilities
5. To promote sustainable and technology-driven community solutions

**Course Outcomes:**

| CO  | Course Outcome                                                          | Bloom's Level |
|-----|-------------------------------------------------------------------------|---------------|
| CO1 | <b>IDENTIFY</b> real-world community problems.                          | 2             |
| CO2 | <b>ANALYZE</b> socio-economic and environmental issues.                 | 4             |
| CO3 | <b>APPLY</b> IT tools/technology to propose solutions.                  | 3             |
| CO4 | <b>DEMONSTRATE</b> effectively in teams and interact with stakeholders. | 3             |
| CO5 | <b>IMPLEMENT</b> sustainable and impactful project solutions.           | 3             |
| CO6 | <b>DEMONSTRATE</b> findings professionally with documentation.          | 3             |

**Course Guidelines for Implementation****1. Team Formation**

The team of 3-4 students should be form with same area/domain of interest.

**2. Guide Allocation and Project Identification:**

- The identified problem statement addressing community challenges must be registered with the project coordinator by the team after consulting with their respective project guide.
- The problem statement should be based on:
  - a) Field visit
  - b) Community Survey
  - c) Real world stakeholder Interaction
- Projects must be:
  - a) Community-based (rural/urban/local)
  - b) Problem-driven (not theoretical)
  - c) IT-enabled/ Technology based solution

**3. Introduction to Software Development Basic Concepts:**

Software Development Life Cycle (SDLC)

Requirement Gathering and Problem Analysis

Work Breakdown Structure (WBS) and Team Task Distribution



### Project Planning using Timeline / Gantt Chart

#### 4. Recommended Languages/Tools/Platforms but not limited to:

- Programming Languages: C Programming, C++ Programming, Python Programming
- Tools: Online Web Designing Tools, AI Tools, Git and GitHub Support
- Platforms / Hardware Platforms: IoT Sensor, Online compilers/any other suitable platform

#### 5. Sample Community Based Problems: Not limited to

##### 1. Air & Noise Problem Pollution:

Develop a low-cost IoT-based real-time system for monitoring air and noise pollution with automated community alerts in urban areas.

##### 2. Career Orientation of Youth:

Create a digital career guidance platform that recommends suitable career paths, skill development courses and job opportunities based on students' interests and aptitude.

##### 3. Misuse of Cell Phones

Develop an AI-based mobile usage monitoring and awareness system to identify excessive screen time, cyberbullying, and unhealthy digital habits among youth.

##### 4. Water Facilities and Drinking Water Availability:

Design an IoT-enabled smart water distribution and quality monitoring system to ensure safe drinking water availability in rural and urban communities.

##### 5. Horticulture:

Develop a smart horticulture management system using IoT sensors for monitoring soil moisture, temperature, and crop health in gardens and farms.

##### 6. Herbal and Nutrition:

Design a mobile application that provides information about medicinal plants, nutritional values, and personalized healthy diet recommendations support

##### 7. Organic Farming:

Develop a smart organic farming assistance system for monitoring crop health, natural fertilizers, and pesticide-free cultivation practices.

##### 8. Incidence of Diabetes and Other Chronic Diseases:

Develop an AI-driven health prediction and monitoring system to identify risk factors and spread awareness about diabetes and chronic diseases.

##### 9. Blood Groups and Blood Levels:

Design a digital blood donor and health record management system for tracking blood groups, hemoglobin levels, and emergency blood availability.

##### 10. Women Education and Empowerment:

Design an AI-enabled women empowerment platform providing educational resources, skill development programs, career guidance, and safety awareness tools.



### **11. Solid Waste and Land Degradation Management**

Design an AI-enabled smart system for automated waste segregation and portable soil analysis system with a mobile app to assess soil health and recommend improvements for communities.

### **12. Climate Change Awareness & Action (AI-Based):**

Develop an AI-driven application to analyze local climate data and suggest actionable strategies to reduce community carbon footprint.

### **13. Natural Disaster Management (Flood/Drought):**

Design a sensor-based early warning system using data analytics to predict and alert communities about flood and drought risks.

### **14. Resource Depletion (Water/Energy/Fuel):**

Develop a data-driven dashboard to monitor and optimize community-level resource consumption for sustainability.

### **15. STEM Activity and Skill Development Portal for orphan students:**

Create an interactive Science, Technology, Engineering and Mathematics (STEM) based activity portal that offers simple science experiments, mathematics games, coding exercises, and technology awareness programs to enhance learning among orphan students.

### **16. STEM Activity: Interactive Visual Learning Platform:**

Develop Science, Technology, Engineering and Mathematics (STEM) based web platform containing animated educational content, visual storytelling and subject-wise learning modules specially designed for Deaf and Hard of Hearing students.

## **6. Documentation and Reporting:**

### **a) Project Diary:**

The students group shall maintain a record of all meetings, remarks given by the guide/reviewers and progress of the work in the project diary, maintaining weekly progress of the project.

### **b) Project Report:**

For the final assessment, students shall complete the project report in all aspects, including formatting, duly signed by the project guide, Project coordinator and Head of Department.

### **Sample format of report:**

1. Title Page
2. Certificate
3. Problem Statement
4. Survey & Data Collection
5. Analysis
6. Proposed Solution with block diagram



7. Implementation Details
8. Results & Impact/Applications
9. Challenges & Learning
10. Conclusion
11. References
12. Annexure (Photos, Data, Feedback)

**7. Event/Competition participation/Copyright:**

The students should present their project work either in internal or external project competition or obtain the copyright for their work.

**8. Mode of Evaluation:**

The evaluation in two phases:

**a) Review-1: Middle of Semester: Weightage:50%**

| Sr. No.      | Evaluation Parameters                  | Marks     |
|--------------|----------------------------------------|-----------|
| 1            | Problem Identification & Survey        | 05        |
| 2            | Analysis & Planning                    | 05        |
| 3            | Solution Design                        | 05        |
| 4            | Applicability and relevance of project | 05        |
| 5            | Implementation Work                    | 05        |
| <b>Total</b> |                                        | <b>25</b> |

**b) Review-2: End of Semester: Weightage:50%**

| Sr. No.      | Evaluation Parameters                     | Marks     |
|--------------|-------------------------------------------|-----------|
| 1            | Workflow Demonstration                    | 05        |
| 2            | Presentation/communication skills         | 05        |
| 3            | Regularity and Team work                  | 05        |
| 4            | Documentation & Report                    | 05        |
| 5            | Event/Competition participation/Copyright | 05        |
| <b>Total</b> |                                           | <b>25</b> |

**Website Links/ Online Resources**

1. **SDLC-Waterfall Model**  
[https://www.tutorialspoint.com/sdlc/sdlc\\_waterfall\\_model.htm](https://www.tutorialspoint.com/sdlc/sdlc_waterfall_model.htm)
2. **Hackathon Project Ideas 2026**  
<https://unstop.com/blog/hackathon-project-ideas>
3. **Smart India Hackathon-2025: Problem Statement Details**  
 Agriculture / Smart Cities / Healthcare / Education / AI / IoT  
<https://www.sih.gov.in/sih2025PS>
4. **Smart India Hackathon-2024: Problem Statement Details**  
 Agriculture/Healthcare/Smart Cities/Sustainability /Transportation/AI /Cybersecurity



<https://www.sih.gov.in/sih2024PS>

**5. UpGrad-Hackathon Project Ideas**

<https://www.upgrad.com/blog/hackathon-project-ideas/>

**6. Hacks for Humanity-ASU Community Hackathon**

<https://www.hacksforhumanity.io/>

**7. Open-Source Project Repositories, Project Type: All Domains**

<https://github.com>

**8. UNESCO: Education for Sustainable Development**

<https://www.unesco.org/en/sustainable-development/education>

**9. Ashoka: Innovators for the Public**

<https://www.ashoka.org>

**10. STEM: Skill Development Projects**

<https://indiastemfoundation.org/csr-education-programs/>

**11. Atal Tinkering Labs: Projects**

<https://aim.gov.in/atl.php>

**12. ISRO STEM Portal: Projects**

<https://www.isro.gov.in/Students.html>

### CO-PO-PSO Mapping

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1   | 1   | 1    | 1    | 2    | 2    | 3    |
| CO2  | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1   | 1   | 1    | 1    | 2    | 2    | 3    |
| CO3  | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1   | 1   | 1    | 1    | 2    | 2    | 3    |
| CO4  | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1   | 1   | 1    | 1    | 2    | 2    | 3    |
| CO5  | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1   | 1   | 1    | 1    | 2    | 2    | 3    |
| CO6  | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1   | 1   | 1    | 1    | 2    | 2    | 3    |
| Avg. | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1   | 1   | 1    | 1    | 2    | 2    | 3    |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE |     |     |     |     |     |
|----------|-----|-----|-----|-----|-----|-----|
|          | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|          | 8   | 8   | 9   | 8   | 8   | 9   |
| L1       | —   | —   | —   | —   | —   | —   |
| L2       | √   | —   | —   | —   | —   | —   |
| L3       | —   | —   | √   | √   | √   | √   |



|           |   |   |   |   |   |   |
|-----------|---|---|---|---|---|---|
| <b>L4</b> | – | √ | – | – | – | – |
| <b>L5</b> | – | – | – | – | – | – |
| <b>L6</b> | – | – | – | – | – | – |

**This course serves as a prerequisite for maps with the following future courses:**

- Software Engineering
- Mini Project
- IoT
- Artificial Intelligence
- Machine Learning
- Data Analytics
- Web Technology
- Mobile Application Development
- Cloud Computing
- Capstone Project / Major Project
- Entrepreneurship and Innovation
- Research Methodology

**Job Mapping:**

**Job/Future opportunities that one can get after learning this course:**

- Education & Training
- Healthcare Outreach
- Government Projects
- Environmental Projects
- Research & Survey Work
- Youth Development Programs
- Entrepreneurship & Social Enterprise



# SEMESTER IV



|                           |                                   |                     |                       |
|---------------------------|-----------------------------------|---------------------|-----------------------|
| <b>Program:</b>           | <b>S. Y. B. Tech: IT</b>          | <b>Semester:</b>    | <b>IV</b>             |
| <b>Course:</b>            | <b>Database Management System</b> | <b>Course Code:</b> | <b>R25-IT-PCC-211</b> |
| <b>Teaching Scheme</b>    |                                   |                     |                       |
| <b>Lecture</b>            | <b>Practical</b>                  | <b>Tutorial</b>     | <b>Credit</b>         |
| <b>03</b>                 | <b>--</b>                         | <b>--</b>           | <b>03</b>             |
| <b>Examination Scheme</b> |                                   |                     |                       |
| <b>CCE</b>                | <b>ESE</b>                        | <b>TW</b>           | <b>PR</b>             |
| <b>40</b>                 | <b>60</b>                         | <b>--</b>           | <b>--</b>             |

**Course Description**

The Database Management System (DBMS) course introduces the fundamental concepts, architecture, and techniques used to design, implement, and manage databases. It covers data models, relational database design, normalization, and Structured Query Language (SQL) for data definition, manipulation, and retrieval. The course also explains transaction management, concurrency control, database security, and recovery mechanisms to ensure data consistency and reliability in multi-user environments. Additionally, students gain an overview of advanced topics such as distributed databases and NoSQL systems, enabling them to design efficient, scalable, and secure database solutions for real-world engineering and software applications.

**Course Relevance:**

Database Management Systems (DBMS) is one of the core subjects in engineering especially for Computer Science, IT, and related branches. The Database Management System (DBMS) course is highly relevant for engineering students as it provides the essential knowledge and skills required to manage and organize large volumes of data efficiently in modern computing applications. Almost every software system, such as web applications, enterprise systems, banking systems, and e-commerce platforms, relies on databases for data storage and retrieval. Understanding DBMS concepts helps students design efficient data models, ensure data integrity and security, and develop scalable applications. This course forms a strong foundation for advanced areas like data analytics, big data, cloud computing, and modern data-driven systems.

**Prerequisite:**

- Basic Programming Knowledge
- Fundamentals of Data Structures

**Bridge Contents:**

- Basics of data organization and information management.
- Fundamentals of programming concepts and problem-solving techniques.

**Course Objectives:**

1. To understand database system architecture and data models.
2. To design relational databases using normalization techniques.
3. To implement SQL queries for data manipulation and retrieval.
4. To understand transaction management and concurrency control.
5. To explore modern database technologies and trends.

**Course Outcomes:** After learning the course, students will be able to

| CO | Course Outcome | Bloom's Level |
|----|----------------|---------------|
|----|----------------|---------------|



|            |                                                                                                                                     |          |
|------------|-------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>CO1</b> | <b>EXPLAIN</b> the fundamental concepts, architecture, and functionalities of database management systems.                          | <b>2</b> |
| <b>CO2</b> | <b>DEMONSTRATE</b> database queries using SQL and PL/SQL for efficient data retrieval and manipulation.                             | <b>3</b> |
| <b>CO3</b> | <b>ANALYZE</b> and design relational database model to represent real-world database applications and demonstrate RDBMS principles. | <b>4</b> |
| <b>CO4</b> | <b>DEMONSTRATE</b> ACID properties for transaction management and describe concurrency control protocols.                           | <b>3</b> |
| <b>CO5</b> | <b>EXPLORE</b> modern database technologies and NoSQL systems.                                                                      | <b>2</b> |

| <b>Course Contents</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                    |               |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|---------------|------------|
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Introduction To Database Management Systems</b> | <b>9 Hrs.</b> | <b>CO1</b> |
| <p><b>Fundamental Concepts:</b> Database System Concepts and Characteristics, File System versus DBMS, Database Users and Administrators, Data Models: Hierarchical, Network, Relational, Object-Oriented, Introduction to RDBMS, Database Performance tuning parameters.</p> <p><b>ER and EER diagrams:</b> Components of ER model, Conventions, Converting ER diagrams into tables, EER Model components, converting EER diagram into tables.</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <ol style="list-style-type: none"> <li>1. ER diagram and relational schema for the Online Retail Store (e.g., Amazon)</li> <li>2. ER diagram and relational schema Library Management System</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                    |               |            |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>SQL and PLSQL</b>                               | <b>9 Hrs.</b> | <b>CO2</b> |
| <p><b>Introduction to SQL:</b> Characteristics and advantages, SQL Data Types and Literals, Data independence, DDL, DML, DCL, TCL, SQL Operators, Tables, Data Definition Language (DDL), Data Manipulation Language (DML), Database Creation, Backup, Database modification using SQL Insert, Update and Delete Queries, Clauses with SELECT statement: WHERE, ORDER BY, Pattern Matching with LIKE, IN, BETWEEN, Aggregate functions with GROUP BY and HAVING, Joins, Nested Queries, Set Operations, Views, Index, Views: Creating, Dropping, Updating using Views, Indexes, Implement all types of queries with the help of real-time application, Embedded SQL, Dynamic SQL, ODBC</p> <p><b>Introduction to PL/SQL:</b> Overview of PL/SQL architecture, control structures, PL/SQL Advanced Features: Procedures and Functions, Cursors, Triggers.</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <ol style="list-style-type: none"> <li>1. Student Result Management System: A college wants a database system to store student information, subjects, and marks. The system should generate results, calculate averages, and automatically update grades.</li> </ol> |                                                    |               |            |



## 2. Database using SQL Queries for Employee Payroll Management System

|               |                                                           |              |            |
|---------------|-----------------------------------------------------------|--------------|------------|
| <b>Unit 3</b> | <b>Relational Database Design, Database Architectures</b> | <b>9 Hrs</b> | <b>CO3</b> |
|---------------|-----------------------------------------------------------|--------------|------------|

**Relational Model:** Relational Model Concepts (Domains, Attributes, Tuples, and Relations), Relational Model Constraints, Relational Database Schemas, Codd's rules. Keys, Integrity Rules, Relational Algebra Operations

**Database design:** Features of good relational database design, Database Design, Purpose of Normalization, Data Redundancy and Data Anomalies, Functional Dependencies, Normal Forms (1NF, 2NF, 3NF, BCNF).

**Database Architectures:** Centralized and Client-Server Architectures, 2 Tier and 3 Tier Architecture, Parallel Databases Architectures, Architecture of Distributed Databases Architecture

**Exemplars/Case studies/Practical Applications and usage:**

1. Hospital Management System: A hospital needs a database to maintain records of patients, doctors, and appointments. The system should avoid redundancy and maintain data consistency.

2. University Course Registration System: A university maintains data of students, courses, and enrollments. The database should avoid duplication and maintain consistency.

|               |                                                       |               |            |
|---------------|-------------------------------------------------------|---------------|------------|
| <b>Unit 4</b> | <b>Transaction Management And Concurrency Control</b> | <b>9 Hrs.</b> | <b>CO4</b> |
|---------------|-------------------------------------------------------|---------------|------------|

**Transaction Management:** Introduction to Database Transaction, Transaction states, ACID Properties, Concept of Schedule: Serial and concurrent Schedule. Serializability: Conflict and View, Cascaded Schedules, Recoverable Schedules.

**Concurrency Control and Recovery Management:**

Need for Concurrency Control, Lock-based protocols, Time stamp-based protocol, Validation-based protocol, Multiple Granularity, Deadlock. Recovery Techniques: Shadow-Paging, Log-based Recovery, Check Point.

**Exemplars/Case studies/Practical Applications and usage:**

1. Online banking system: In an online banking system, customers frequently perform transactions such as deposit, withdrawal, and fund transfer. The database must maintain accuracy and consistency even when multiple users access the system simultaneously.

2. Airline Reservation System: Thousands of passenger book tickets simultaneously. The system must ensure that two passengers do not book the same seat.

|               |                                                     |               |            |
|---------------|-----------------------------------------------------|---------------|------------|
| <b>Unit 5</b> | <b>Recent Trends in Database Management Systems</b> | <b>9 Hrs.</b> | <b>CO5</b> |
|---------------|-----------------------------------------------------|---------------|------------|

**Introduction to NoSQL Databases:** Challenges with traditional databases, Need for scalability, flexibility, and speed. NOSQL Databases: Definition and types, Document, Key-



Value, Column, Graph, Example using MongoDB and MongoDB Queries.

**Big Data and Hadoop:** Basics of Big Data, Introduction to Hadoop and HDFS, Real-world examples (e.g., social media, online shopping), Simple explanation of how they store relationships.

**Cloud Databases:** What is DBaaS (Database-as-a-Service), Examples: AWS/Google Firebase; Benefits: scalability, cost, easy setup.

**AI/ML with Databases:** Basic idea of machine learning inside databases, Real-world applications: recommendations, fraud detection. AI Integration in Databases

**Exemplars/Case studies/Practical Applications and usage:**

1. Short quiz on types of NoSQL databases
2. Comparative of SQL and NoSQL databases

**Textbooks**

1. Silberschatz A., Korth H. F., Sudarshan S., *Database System Concepts*, 7th Edition, 2019, McGraw-Hill Education, ISBN 978-1260084504

**Reference Books**

1. Elmasri R., Navathe S., *Fundamentals of Database Systems*, 7th Edition, 2021, Pearson Education, ISBN:978-0137502523.
2. Gupta G. K., *Database Management Systems*, Latest Edition, 1<sup>st</sup> Edition Reprint, 2011, Tata McGraw-Hill Education, ISBN 978-0070702080.
3. Date C. J., *An Introduction to Database Systems*, 8th Edition, 2004, Pearson Education, ISBN 978-0321197849.
4. Ramakrishnan R., Gehrke J., *Database Management Systems*, 3rd Edition, 2003, McGraw-Hill. ISBN 978-0072465631.
5. Feuerstein S., *Oracle PL/SQL Programming*, 6th Edition, 2014, O'Reilly Media, ISBN 978-1449324452.
6. Bayross, Ivan, *SQL, PL/SQL: The Programming Language of Oracle*. Latest ed, 2010, BPB Publications. ISBN 978-8176569262
7. Sadalage P. J., Fowler M., *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*, 1st Edition, 2012, Addison-Wesley, ISBN 978-0321826626.
8. Mahmood Z. (Ed.), *Cloud Computing: Concepts, Technology and Architecture*, 1st Edition, 2011, Springer, ISBN 978-1441965240.

**Website Links/ Online Resources:**

1. MongoDB Inc., MongoDB Manual (Official Documentation):

<https://www.mongodb.com/docs/>

2. Data Base Management System: Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay, IIT Kharagpur

[https://onlinecourses.nptel.ac.in/noc26\\_cs39/preview](https://onlinecourses.nptel.ac.in/noc26_cs39/preview)

3. Fundamentals of Database Systems: Prof. Arnab Bhattacharya, IIT Kanpur

<https://nptel.ac.in/courses/106104135>

4. Structure Query Language: SQL

<https://www.youtube.com/watch?v=5OdVJbNCSso>

5. Master Oracle PLSQL:

<https://www.youtube.com/watch?v=9ic3KEH4Ah4>

**CO-PO Mapping**

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 2   | 1   | 1   | 1   | 1   | 1   | 1   | 2   | 1    | 3    | 3    | 3    | 2    |
| CO2  | 3   | 3   | 3   | 1   | 2   | 1   | 1   | 2   | 2   | 1    | 3    | 3    | 3    | 2    |
| CO3  | 2   | 3   | 3   | 1   | 3   | 1   | 1   | 2   | 2   | 1    | 3    | 3    | 3    | 2    |
| CO4  | 2   | 3   | 2   | 2   | 1   | 2   | 1   | 2   | 3   | 1    | 3    | 3    | 3    | 2    |
| CO5  | 2   | 2   | 1   | 1   | 2   | 2   | 1   | 2   | 3   | 1    | 3    | 2    | 3    | 1    |
| Avg. | 2.4 | 2.6 | 2   | 1.2 | 1.8 | 1.4 | 1   | 1.8 | 2.4 | 1    | 3    | 2.8  | 3    | 1.8  |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Assessment Pattern**

| BT Level | CCE |     |     |     |     | ESE |     |     |     |     |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|          | CO1 | CO2 | CO3 | CO4 | CO5 | CO1 | CO2 | CO3 | CO4 | CO5 |
|          | 8   | 8   | 8   | 8   | 8   | 12  | 12  | 12  | 12  | 12  |
| L1       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |
| L2       | √   | —   | —   | —   | √   | √   | —   | —   | —   | √   |
| L3       | —   | √   | —   | √   | —   | —   | √   | —   | √   | —   |
| L4       | —   | —   | √   | —   | —   | —   | —   | √   | —   | —   |
| L5       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |
| L6       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |

This course serves as a prerequisite for maps with the following future courses:

- Data Mining and Data Warehousing



- Big Data Analytics
- Cloud Computing
- Artificial Intelligence and Machine Learning
- Web Technologies / Web Application Development:
- Information Retrieval Systems
- Software Engineering / Enterprise Application Development:

**Job Mapping:**

**Job/Future opportunities that one can get after learning this course:**

- Database Administrator (DBA)
- Data Analyst
- Software Developer
- Data Engineer
- Business Intelligence (BI) Developer
- Cloud Database Engineer
- Database Developer
- Data Scientist
- System Analyst



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |                     |        |                    |     |                |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------|--------|--------------------|-----|----------------|---------------|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                | S. Y. B. Tech       |        | Semester:          |     | IV             |               |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                | Applied Mathematics |        | Course Code:       |     | R25-IT-PCC-212 |               |
| Teaching Scheme (Hrs./Week)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                |                     |        | Examination Scheme |     |                |               |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Practical      | Tutorial            | Credit | CCE                | ESE | TW             | PR            |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | --             | --                  | 02     | 40                 | 60  |                | --            |
| <b>Course Description</b><br>This course provides a comprehensive introduction to the discrete and statistical mathematical structures essential for computer science and engineering. It covers Set Theory and Logic as the basis for database and algorithm design; Statistics and Probability for data analysis; and Hypothesis Testing for scientific validation. The final module integrates Number Theory and Combinatorics, which are the fundamental pillars of modern cryptography, cybersecurity, and algorithmic efficiency.                                                                                            |                |                     |        |                    |     |                |               |
| <b>Course Relevance</b> <ul style="list-style-type: none"><li>• Data Science: Statistics, Probability, and Hypothesis Testing are mandatory for machine learning and big data analytics.</li><li>• Cybersecurity: Number Theory (Modular Arithmetic, Primes) is the engine behind RSA and ECC encryption.</li><li>• Database Management: Set theory and Relations directly inform SQL operations and relational database design.</li><li>• Algorithm Design: Combinatorics and Logic are used to calculate computational complexity and optimize code performance.</li></ul>                                                       |                |                     |        |                    |     |                |               |
| <b>Prerequisite:</b> <ul style="list-style-type: none"><li>• Basic understanding of Algebra and Arithmetic.</li><li>• Familiarity with Elementary Calculus (for continuous probability distributions).</li><li>• Foundational knowledge of Number Systems (Binary, Decimal, Hexadecimal).</li></ul>                                                                                                                                                                                                                                                                                                                                |                |                     |        |                    |     |                |               |
| <b>Bridge Content:</b><br>To ensure all students are aligned, the course will begin with a brief review of: <ul style="list-style-type: none"><li>• Basic Logic Gates: Bridging high school physics with Propositional Logic.</li><li>• Permutation/Combination Basics: Reviewing <math>n!</math> notation before moving to advanced Combinatorics.</li><li>• Descriptive Statistics: A refresher on Mean, Median, and Mode before tackling Kurtosis and Skewness.</li></ul>                                                                                                                                                       |                |                     |        |                    |     |                |               |
| <b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To develop logical thinking and power of abstraction through Set Theory and Relations.</li><li>2. To provide students with the statistical tools necessary to interpret and analyze real-world data.</li><li>3. To introduce the concept of Probability Distributions and their role in predicting system behavior.</li><li>4. To enable students to perform rigorous Hypothesis Testing for making data-driven decisions.</li><li>5. To master the principles of Number Theory and Combinatorics required for security and algorithmic optimization.</li></ol> |                |                     |        |                    |     |                |               |
| <b>Course Outcomes:</b> On completion of the course, learner will be able to -:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |                     |        |                    |     |                |               |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Course Outcome |                     |        |                    |     |                | Bloom's Level |



|     |                                                                                                                                                  |          |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| CO1 | <b>APPLY</b> set operations and relational properties to model data structures and simplify logical propositions.                                | <b>3</b> |
| CO2 | <b>DEMONSTRATE</b> large IT datasets using statistical measures, probability distributions, and inequalities to model uncertainty in IT systems. | <b>3</b> |
| CO3 | <b>EXECUTE</b> statistical tests to accept or reject technical hypotheses.                                                                       | <b>3</b> |
| CO4 | <b>SOLVE</b> complex problems in cryptography and counting using Number Theory and advanced Combinatorial principles.                            | <b>3</b> |

| Course Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                               |        |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------|-----|
| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Sets, Relations and Functions | 7 Hrs. | CO1 |
| <p><b>Sets</b>-Naïve set theory, Axiomatic set theory, Set Operations, Cardinality of set, Types of set, Propositional logic,<br/> <b>Relations</b>-Relations &amp; Properties, Representations of Relations, Closures of Relations. Equivalence Relations, Hasse Diagram, Lattices, Chains &amp; Anti Chains, Warshall's Algorithm<br/> <b>Functions</b> &amp; Types of Functions</p> <p><b>Exemplars / Practical Applications, Usage:</b></p> <p>An IT company monitors its cloud servers by tracking API requests and their response times. The system treats API requests as a set and defines a function that maps each request to its response time.</p> <ol style="list-style-type: none"> <li>Collect / Simulate Data (Set Formation)</li> <li>Apply Function Mapping</li> <li>Check Properties of Function</li> <li>Compute Numerical Measures (Using Function Output)</li> <li>Define Performance Function</li> </ol> |                               |        |     |
| Unit 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Statistics and Probability    | 8 Hrs. | CO2 |
| <p>Study of statistical measures including central tendency, dispersion. Moments, skewness, kurtosis, correlation, regression, and interpretation of statistical data.<br/> Probability: Introduction to probability including sample space, events, addition and multiplication theorems, conditional probability, probability distributions such as Binomial, Poisson, and Normal distribution.</p> <p><b>Exemplars / Practical Applications, Usage:</b></p> <p>An E-Commerce company monitors website traffic and transaction success rates to evaluate server performance during online sales. Statistics and probability help analyze customer behavior, transaction reliability, and system efficiency.</p> <ol style="list-style-type: none"> <li>Collect or Simulate Sample Data</li> <li>Compute Statistical Measures</li> <li>Apply Probability Concepts</li> <li>Use Normal Distribution (Approximation)</li> </ol>  |                               |        |     |
| Unit 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Hypothesis Testing            | 7 Hrs. | CO3 |



Introduction, Statistical Hypothesis (Simple and-Composite), Test of a Statistical Hypothesis, Null Hypothesis, Alternative Hypothesis, Critical Region, Type I and Type II errors, level of significance, hypothesis testing using Chi-square Test, t-test, F-test, Z-test

#### **Exemplars / Practical Applications, Usage:**

#### **Exemplars / Practical Applications, Usage:**

An Internet Service Provider (ISP) company claims average internet speed is 100 Mbps. After optimization, engineers test 64 users and obtain:

- i. Sample mean ( $\bar{x}$ )=108 Mbps
- ii. Population standard deviation ( $\sigma$ )=16 Mbps
- iii. Sample size ( $n$ )=64
- iv. Test whether optimization improved speed.

|               |                                        |               |            |
|---------------|----------------------------------------|---------------|------------|
| <b>Unit 4</b> | <b>Number Theory and Combinatorics</b> | <b>8 Hrs.</b> | <b>CO4</b> |
|---------------|----------------------------------------|---------------|------------|

Number Theory: Prime Numbers and Their Distribution, Modular Arithmetic, Chinese Remainder Theorem, Quadratic Residues and Legendre Symbol

Combinatorics: Permutations, Combinations, Principle of Inclusion and Exclusion, Pigeonhole principle, Generating Function

#### **Exemplars / Practical Applications, Usage:**

A healthcare technology company develops a secure digital patient monitoring and medical record management system. The system uses:

- i. Prime numbers for securing patient data through encryption techniques
- ii. Modular arithmetic for generating secure access codes and authentication keys
- iii. Chinese Remainder Theorem (CRT) for efficient processing of distributed medical databases
- iv. Quadratic residues for secure user verification and digital signatures
- v. Combinatorics for appointment scheduling, medical resource allocation and generating unique patient IDs

#### **Textbooks:**

1. Rosen, Kenneth H., Discrete Mathematics and Its Applications, 7<sup>th</sup> ed. 2019, McGraw-Hill Education, ISBN 978-0073383095.
2. Lipschutz, Seymour, and Marc Lipson, Discrete Mathematics. Schaum's Outline Series, 3<sup>rd</sup> ed. 2009, McGraw-Hill Education, ISBN 978-0071615860
3. Gupta, S.C., and V.K. Kapoor, Fundamentals of Mathematical Statistics, 12<sup>th</sup> ed., 2020, Sultan Chand & Sons, ISBN 978-9351611295
4. Deo, Narsingh, Graph Theory with Applications to Engineering and Computer Science, 1<sup>st</sup> ed., 2017, PHI Learning, ISBN 978-8120321458

#### **Reference Books:**



1. Tremblay, John P., and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, 1<sup>st</sup> ed., 1975, McGraw-Hill Education, ISBN 978-0070651425
2. Ross, Sheldon, A First Course in Probability. Pearson Education, 9<sup>th</sup> ed., 2014. ISBN 978-0321794772
3. Johnson, Richard A., and Dean W. Wichern, Applied Multivariate Statistical Analysis, 6<sup>th</sup> ed., 2018, Pearson Education, ISBN 978-0136807391
4. West, Douglas B., Introduction to Graph Theory, 2<sup>nd</sup> ed., 2001, Prentice Hall, ISBN 978-0130144003

#### Web Site link and online Recourses :

1. **Set and Function: By Prof. Dipanwita Roychoudhury, IIT Kharagpur**  
<https://youtu.be/kLKIPOkSR8?si=snI3XdVseJA3kvC3>
2. **Statistics & Probability: By Prof. S. Dharmaraja, IIT Delhi**  
<https://youtu.be/1NPBMF2T8Iw?si=NFIZByxt-xPgKIcM>
3. **Hypothesis Testing: By Prof. Jitesh J Thakkar, IIT Kharagpur**  
<https://youtu.be/6zslEdMGGiQ?si=2YDHzi8QUjmWXwYt>
4. **Number Theory and Combinatorics: By Prof. Nitin Saxena, IIT Kanpur**  
[https://youtu.be/OjggAmbhS9c?si=BoZ06j6u\\_-YFvZqy](https://youtu.be/OjggAmbhS9c?si=BoZ06j6u_-YFvZqy)

#### Strength of CO-PO-PSO Mapping

| CO  | PO1  | PO2  | PO3 | PO4 | PO5 | PO6 | PO7  | PO8  | PO9  | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|------|------|-----|-----|-----|-----|------|------|------|------|------|------|------|------|
| CO1 | 2    | 2    | -   | -   | -   | -   | 2    | 2    | 1    | -    | 2    | 3    | 2    | 1    |
| CO2 | 3    | 3    | -   | -   | -   | -   | 2    | 2    | 1    | -    | 2    | 3    | 3    | 1    |
| CO3 | 2    | 2    | -   | -   | -   | -   | 2    | 2    | 1    | -    | 2    | 2    | 3    | 1    |
| CO4 | 3    | 3    | -   | -   | -   | -   | 2    | 2    | 1    | -    | 2    | 3    | 3    | 2    |
| Avg | 2.50 | 2.50 | -   | -   | -   | -   | 2.00 | 2.00 | 1.00 | -    | 2.00 | 2.75 | 2.75 | 1.25 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

#### Assessment Pattern

| BT<br>Level | CCE |     |     |     | ESE |     |     |     |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|
|             | CO1 | CO2 | CO3 | CO4 | CO1 | CO2 | CO3 | CO4 |
|             | 10  | 10  | 10  | 10  | 15  | 15  | 15  | 15  |
| L1          | —   | —   | —   | —   | —   | —   | —   | —   |
| L2          | —   | —   | —   | —   | —   | —   | —   | —   |
| L3          | √   | √   | √   | √   | √   | √   | √   | √   |



|           |   |   |   |   |   |   |   |   |
|-----------|---|---|---|---|---|---|---|---|
| <b>L4</b> | — | — | — | — | — | — | — | — |
| <b>L5</b> | — | — | — | — | — | — | — | — |
| <b>L6</b> | — | — | — | — | — | — | — | — |

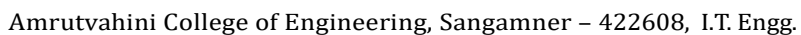
**This course serves as a prerequisite for / maps with the following future courses:**

- Data Structures and Algorithms
- Database Management Systems (DBMS)
- Artificial Intelligence and Machine Learning
- Data Science and Big Data Analytics
- Cryptography and Cyber Security
- Theory of Computation / Automata Theory
- Computer Networks and Cloud Computing
- Blockchain Technology
- Software Engineering and Quality Assurance
- GATE Exam/ CAT Exam /Aptitude Tests

**Job Mapping:**

Job opportunities that one can get after learning this course:

- Data Analyst
- Data Scientist
- Machine Learning Engineer
- Business Intelligence Analyst
- Statistician / Statistical Programmer
- Cyber Security Analyst
- Cryptography Engineer
- Cloud Performance Analyst
- Database Developer / Database Administrator
- Software Developer / Software Engineer
- AI & Data Analytics
- Quality Assurance (QA) Analyst
- Network Security Engineer



Rev.No:00, Date:19/6/2026

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                        |                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------|
| <p><b>Course Description</b></p> <p>The Object-Oriented Programming course introduces students to fundamental principles of object-oriented design and programming using Java. The course covers concepts such as classes, objects, inheritance, polymorphism, encapsulation, abstraction, constructors, methods, packages, exception handling, and multithreading. It emphasizes designing reusable and maintainable software systems using OOP principles and implementing them through Java programming.</p> |                                                                                        |                      |
| <p><b>Course Relevance:</b></p> <p>Object Oriented Programming forms the foundation for modern software development. Most modern programming languages such as Java, Python, C#, and C++ are based on object-oriented concepts. The course helps students understand software design principles, code modularity, and reusable components which are widely used in enterprise applications, web development, mobile applications, and system software.</p>                                                      |                                                                                        |                      |
| <p><b>Prerequisite:</b></p> <p>Programming Fundamentals :C languages</p>                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                        |                      |
| <p><b>Bridge Content: --</b></p> <ul style="list-style-type: none"> <li>▪ Basic Java concepts: program structure, data types, operators, control statements.</li> <li>▪ Fundamentals of Object-oriented concepts and problem-solving</li> </ul>                                                                                                                                                                                                                                                                 |                                                                                        |                      |
| <p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To understand principles of object-oriented programming.</li> <li>2. To apply classes, objects, methods, and constructors in java programs.</li> <li>3. To implement inheritance, polymorphism, abstraction, and encapsulation.</li> <li>4. To develop java applications using packages, interfaces, and exception handling.</li> <li>5. To analyze file handling techniques and basic modern java concepts</li> </ol>               |                                                                                        |                      |
| <p><b>Course Outcomes:</b> After learning the course, students will be able to</p>                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                        |                      |
| <b>CO</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Course Outcome</b>                                                                  | <b>Bloom's Level</b> |
| <b>CO1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>DESCRIBE</b> basic concepts of Object-Oriented Programming                          | <b>2</b>             |
| <b>CO2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>APPLY</b> classes, objects, methods and constructors in Java                        | <b>3</b>             |
| <b>CO3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>IMPLEMENT</b> inheritance, polymorphism, abstraction, and encapsulation             | <b>3</b>             |
| <b>CO4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>APPLY</b> exception handling and multithreading concepts in Java programs, packages | <b>3</b>             |



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                              |               |            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|---------------|------------|
| <b>CO5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>ANALYZE</b> recent trends in IT Industry.                 | <b>4</b>      |            |
| <b>Course Contents</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                              |               |            |
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Foundations of Object-Oriented Programming Using Java</b> | <b>9 Hrs.</b> | <b>CO1</b> |
| <p><b>Introduction to Java Programming:</b> History and Features of Java, Java Development Environment, Java Virtual Machine (JVM), Java Runtime Environment (JRE), Java Development Kit (JDK), Java data types, Control statements, Command line arguments, Structure of Java Program.</p> <p><b>Introduction to Programming Paradigms:</b> Procedural Programming vs Object Oriented Programming, Limitations of Procedural Programming (C language), Need of Object-Oriented Programming, Basic principles of OOP: Encapsulation, Abstraction, Inheritance, Polymorphism.</p> <p><b>Classes and Objects:</b> Class definition, Object creation, Instance variables and methods, Access specifiers</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <ol style="list-style-type: none"> <li>1. Design a Student Information System to demonstrate class, object, and basic attributes.</li> <li>2. Create a Bank Account model showing real-world object representation (balance, deposit, withdraw).</li> </ol> |                                                              |               |            |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Arrays, Methods and Constructors</b>                      | <b>9 Hrs.</b> | <b>CO2</b> |
| <p><b>Arrays in Java:</b> One-dimensional arrays, Two-dimensional arrays, Array operations and applications in Java programs, Advantages</p> <p><b>Methods in Java:</b> Concept of methods within a class, Method declaration and definition, Method calling, Types of methods (instance and static methods), Parameter passing in methods, Call by value in Java, Method overloading, Method Overriding</p> <p><b>Constructors:</b> Concept and purpose of constructors, Types of constructors (Default constructor, Parameterized constructor, Copy Constructor), Constructor overloading, Use of this keyword, Difference between constructor and method, Memory allocation and Garbage Collection in Java, Destructor.</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <ol style="list-style-type: none"> <li>1. Develop a Bank Account System using constructors (default + parameterized).</li> <li>2. Implement a Student Marks Analysis System using arrays (average, max, min).</li> </ol>              |                                                              |               |            |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Inheritance, Polymorphism and Abstraction</b>             | <b>9 Hrs.</b> | <b>CO3</b> |
| <p><b>Inheritance in Java:</b> Concept of inheritance, Types of inheritance (Single, Multilevel, Hierarchical), Use of extends keyword, Use of super keyword, Method overriding, Dynamic method dispatch (runtime polymorphism), IS-A relationship.</p> <p><b>Polymorphism:</b> Concept of polymorphism, Compile-time polymorphism (Method overloading), Runtime polymorphism (Method overriding), Dynamic binding, Advantages of polymorphism.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                              |               |            |



**Encapsulation:** Concept of encapsulation, Data hiding and data security, Use of access modifiers (private, protected, public), Getter and Setter methods, Advantages of encapsulation.

**Abstraction:** Concept of abstraction, Abstract classes and abstract methods, Interfaces in Java, Difference between abstract class and interface, Multiple inheritance using interfaces.

**Object Relationships :** Association, Aggregation, Composition, HAS-A relationship (basic concept only).

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**Exemplars/Case studies/Practical Applications and usage:**

1. Develop a Library Management System using inheritance and polymorphism.
2. Create a Shape hierarchy program using abstract classes/interfaces.
3. Organize a multi-class application using packages (e.g., student, utility packages).

|               |                                                                   |               |            |
|---------------|-------------------------------------------------------------------|---------------|------------|
| <b>Unit 4</b> | <b>Exception Handling, Multithreading and Generic Programming</b> | <b>9 Hrs.</b> | <b>CO4</b> |
|---------------|-------------------------------------------------------------------|---------------|------------|

**Packages in Java:** Concept of packages, creating packages, accessing packages, advantages of packages (basic concept only)

**Exception Handling in Java:** Concept of exception, Types of exceptions (Checked and Unchecked), Exception handling using try and catch blocks, Use of finally block, Multiple catch blocks, Use of throw and throws keywords, User-defined exceptions (basic concept).

**Multithreading in Java:** Concept of multithreading, Need of multithreading, Thread life cycle, Creating threads using Thread class and Runnable interface, Thread methods (sleep, join), Thread synchronization (basic concept), Inter-thread communication (introduction only).

**Generics:** What are Generics? Introduction to Language Specific Collection Interface: List Interface and Set Interface, Collection Classes: ArrayList Class and LinkedList Class.

---

**Exemplars/Case studies/Practical Applications and usage:**

1. Develop a File-based Student Record System with exception handling.
2. Create a Multi-threaded application (e.g., ticket booking simulation or simple counter threads).

|               |                                                  |               |            |
|---------------|--------------------------------------------------|---------------|------------|
| <b>Unit 5</b> | <b>File Handling in Java and Modern Concepts</b> | <b>9 Hrs.</b> | <b>CO4</b> |
|---------------|--------------------------------------------------|---------------|------------|

**File Handling in Java:** Fundamentals of files, Types of files (Text and Binary), File operations (Create, Read, Write, Append, Delete), File paths (Absolute and Relative), Directory concept. File class: Creating files, checking existence, file properties, directory handling.

**Streams in Java:** Byte streams (FileInputStream, FileOutputStream), Character streams (FileReader, FileWriter), Difference between byte and character streams, Buffered streams: BufferedReader and BufferedWriter, reading data line by line, concept of buffering.

**Serialization and Exception handling:** Serialization: Concept of serialization, Serializable interface, ObjectOutputStream and ObjectInputStream, basic use cases, Exception handling in file operations: IOException and FileNotFoundException, use of try-catch-finally.



**Modern Java Concepts:** Basics of Lambda expressions, Introduction to Stream API.

**Exemplars/Case studies/Practical Applications and usage:**

1. Develop a File Handling Application to: a) Read/write student data b) Use BufferedReader/Writer
2. Implement a serialization example (store and retrieve objects).
3. Mini case: Analyze performance difference between byte stream vs character stream.

**Textbooks:**

1. Herbert Schildt & Danny Coward – Java: The Complete Reference, 13th Edition, 2024, McGraw Hill, ISBN-13: 978-1265058432.
2. Kathy Sierra, Bert Bates & Trisha Gee -Head First Java, 3rd Edition, 2022, O'Reilly Media, ISBN-13: 978-1491910771.
3. E. Balagurusamy -Object Oriented Programming with Java, 7th Edition, 2020, McGraw Hill, ISBN-13: 978-9353162344.

**Reference Books:**

1. Cay S. Horstmann – Core Java Volume I: Fundamentals, 12th Edition, 2021, Pearson, ISBN:978-0137673629.
2. Bruce Eckel, Thinking in Java, 4th Edition, 2006, Prentice Hall, ISBN: 978-0131872486.
3. Scott Chacon & Ben Straub, Pro Git, 2nd Edition, 2014, Apress, ISBN: 978-1484200773.

**Website Links/ Online Resources**

1. Core Java Programming Virtual Lab-IIT Delhi,  
<https://java-iitd.vlabs.ac.in/>
2. Fundamentals of Object-Oriented Programming: Prof. Balasubramanian Raman, IIT Roorkee  
<https://nptel.ac.in/courses/106107574>
3. Programming In Java, Prof. Debasis Samanta, IIT Kharagpur,  
<https://nptel.ac.in/courses/106105191>
4. Object-Oriented Programming Concepts- GeeksforGeeks  
<https://www.geeksforgeeks.org/object-oriented-programming-oops-concept-in-java/>
5. Java OOP Tutorial -W3Schools  
[https://www.w3schools.com/java/java\\_oop.asp](https://www.w3schools.com/java/java_oop.asp)
6. OOP in Python- Programiz  
<https://www.programiz.com/python-programming/object-oriented-programming>



## 7. Oracle Java Documentation- OOP Concepts

<https://docs.oracle.com/javase/tutorial/java/concepts/>

**CO-PO Mapping**

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 2   | 3   | 2   | 3   | 2   | 1   | 1   | 1   | -    | 2    | 3    | 2    | 3    |
| CO2  | 3   | 2   | 2   | 2   | 3   | 2   | 2   | 1   | 1   | -    | 2    | 3    | 2    | 2    |
| CO3  | 3   | 2   | 2   | 2   | 2   | 2   | 1   | 2   | 1   | -    | 2    | 2    | 2    | 2    |
| CO4  | 3   | 2   | 2   | 2   | 3   | 2   | 2   | 1   | 1   | 1    | 3    | 3    | 2    | 2    |
| CO5  | 3   | 2   | 2   | 2   | 3   | 2   | 2   | 1   | 1   | 1    | 3    | 3    | 2    | 2    |
| Avg. | 2.8 | 2   | 2.2 | 2   | 2.8 | 2   | 1.4 | 1   | 1   | 1    | 2    | 2.8  | 2    | 2.2  |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Assessment Pattern**

| BT Level | CCE |     |     |     |     | ESE |     |     |     |     |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|          | CO1 | CO2 | CO3 | CO4 | CO5 | CO1 | CO2 | CO3 | CO4 | CO5 |
|          | 8   | 8   | 8   | 8   | 8   | 12  | 12  | 12  | 12  | 12  |
| L1       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |
| L2       | √   | —   | —   | —   | —   | √   | —   | —   | —   | —   |
| L3       | —   | √   | √   | √   | —   | —   | √   | √   | √   | —   |
| L4       | —   | —   | —   | —   | √   | —   | —   | —   | —   | √   |
| L5       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |
| L6       | —   | —   | —   | —   | —   | —   | —   | —   | —   | —   |

**This course serves as a prerequisite for maps with the following future courses:**

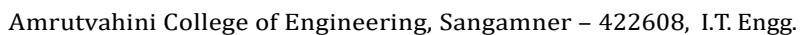
- Software Engineering
- Design and Analysis of Algorithms
- Advanced Java
- Web Technologies
- Full Stack Development
- Database Management Systems
- Final Year Project / Capstone Project

**Job Mapping:****Job/Future opportunities that one can get after learning this course:**

- Java Developer
- Software Developer
- Application Developer
- Android Developer
- Full Stack Developer
- Software Tester
- System Analyst



- Technical Consultant
- Higher Studies (M.Tech /MS)
- Entrepreneur / Startup Founder



Rev.No:00, Date:19/6/2026

## Course Description

Processor Architecture is a core subject that focuses on the design and working of microcontrollers (especially PIC18) and modern processors like ARM. It covers architecture, programming, interfacing, and real-world embedded applications. The course helps students understand how hardware and software interact in embedded systems.

**Course Relevance:**

Forms the foundation for embedded systems, IoT, and hardware-software integration

Important for careers in: Embedded systems engineering Robotics and automation Electronics & firmware development Helps in understanding real-time systems and processor-level programming

Builds knowledge required for advanced subjects like: Embedded Systems Internet of Things (IoT)

**Computer Architecture** In short: This subject connects theory of processors with practical applications used in modern devices.

**Prerequisite:**

# Digital Electronics and Logic Design

**Bridge Content: --**

- Review of logic gates and Boolean algebra
- Combinational and sequential circuit concepts
- Flip-flops, registers, counters and shift registers
- Memory organization and bus architecture

### Course Objectives:

1. **INTRODUCE** the basic concepts, history, and evolution of microcontrollers and differentiate them from microprocessors.
2. **STUDY** the internal structure of I/O ports and learn how to configure them for input/output operations in PIC microcontrollers.
3. **UNDERSTAND** the interfacing of peripheral devices.
4. **STUDY** the architecture, features, and versions of ARM processors such as ARM7, ARM9, and ARM11.

**Course Outcomes:** After learning the course, students will be able to

## Course Contents



| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Modern Microprocessor Architecture             | 7 Hrs. | CO1 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------|-----|
| <p>Introduction to Computer Processors, Evolution of Microprocessors Difference between Microprocessor and Microcontroller Processor Organization, ALU Control unit, Registers, cache memory, buses CISC vs RISC Architecture Pipelining and Superscalar Architecture Introduction to Modern Processor Families: Intel Core 7/i9.</p> <p>ARM and RISC design philosophy, Introduction to ARM processor &amp; its versions ARM 7, ARM 9, ARM 11, Features&amp; advantages of ARM processor, Suitability of ARM processor in embedded applications.</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <ol style="list-style-type: none"> <li>1. Personal Computers and Laptops, Servers</li> <li>2. Apple M-Series Processor in MacBook Systems</li> </ol>                                                |                                                |        |     |
| Unit 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Microcontroller Architecture & Embedded System | 8 Hrs. | CO2 |
| <p>Introduction to Embedded Systems Introduction: to microcontroller, Brief history of microcontrollers PIC18F: Features and architecture, comparison of PIC 18 series microcontrollers; PIC18F458/452 Pin out connection, Program memory and data memory organization. PIC I/O ports, Timer/Counter, Programming of Timers using Embedded C. Typical Applications of PIC Microcontroller</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <ol style="list-style-type: none"> <li>1. LED Blinking using I/O Port and Timer0</li> <li>2. Traffic Light Control using Timer1</li> </ol>                                                                                                                                                                                                                  |                                                |        |     |
| Unit 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | PIC Interrupts and Interfacing                 | 7 Hrs. | CO3 |
| <p>PIC Interrupts: Interrupt Versus Polling, IVT, Steps in executing interrupt, Sources of interrupts; Enabling and disabling interrupts, Interrupt registers, Priority of interrupts, Interfacing of LED, Interfacing 16X2 LCD (8 bits) and Key board (4 x 4 Matrix), and Interfacing Relay &amp; Buzzer. CCP modes: Capture, Compare and PWM generation, DC Motor speed control with CCP, Stepper motor interfacing with PIC, Basics of Serial communication protocols: Study of RS232, I2C, SPI, UART, Serial communication programming using Embedded C.</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b></p> <ol style="list-style-type: none"> <li>1. Automatic Water Tank Level Indicator using Timer Interrupt + LED</li> <li>2. Password Door Lock using 4x4 Keyboard + Relay + Buzzer</li> </ol> |                                                |        |     |
| Unit 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | GPU Architecture and Parallel Computing        | 8 Hrs. | CO4 |
| <p>Introduction to GPU and its evolution, Difference between CPU and GPU, GPU architecture &amp; its components, Application &amp; advantages of GPU, GPU Memory Hierarchy, SIMD and SIMT Concepts, CUDA Programming Basics, AI and Deep Learning Acceleration using GPU in Gaming, Scientific Computing and AI Introduction to Ray Tracing, GPU for Generative AI Applications, NPU and its evolution, Difference between CPU, GPU and NPU.</p>                                                                                                                                                                                                                                                                                                                                                                                 |                                                |        |     |



**Exemplars/Case studies/Practical Applications and usage:**

1. GPU Usage in ChatGPT and AI Systems
2. NVIDIA GPUs for Deep Learning

**Textbooks:**

1. Rolin D. McKinlay Muhammad Ali Mazidi, Danny E. Causey, PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18. 2nd ed, 2017, Pearson Education. ISBN 978-0131194045
2. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide: Designing and Optimizing System Software. 1st ed, 2004, Morgan Kaufmann Publishers. ISBN 978-1558608740

**Reference Books:**

1. John B Peatman, Design with PIC Microcontrollers. 1st ed, 1998, Pearson Education PTE. ISBN 978-0137592593
2. Ramesh S. Gaonkar, Fundamentals of Microcontrollers and Applications in Embedded Systems (with the PIC18 Microcontroller Family). 1st ed, 2007, Thomson/Delmar Learning. ISBN 978-1401879143
3. Muhammad Ali Mazidi, ARM Assembly Language Programming & Architecture. 1<sup>st</sup> edition, 2016. ISBN 978-0997925906
4. Microchip Technology Inc., PIC18FXXX Data Sheet DS39582B.  
<https://ww1.microchip.com/downloads/en/DeviceDoc/30327b.pdf>

**Website Links/ Online Resources**

1. Microprocessors and Microcontrollers: Prof. Santanu Chattopadhyay, IIT Kharagpur  
[https://onlinecourses.nptel.ac.in/e-learning/preview/noc25\\_ee49](https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee49)
2. GPU Architectures and Programming: Prof. Soumyajit Dey, IIT Kharagpur  
[https://onlinecourses.nptel.ac.in/e-learning/preview/noc25\\_cs37](https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_cs37)
3. Computer Architecture: By Prof. Smruti R. Sarangi, IIT Delhi  
<https://nptel.ac.in/courses/106102157>

**CO-PO-PSO Mapping**



| CO /PO | PO1 | PO2 | PO3  | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|--------|-----|-----|------|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1    | 3   | 2   | -    | -   | -   | -   | -   | -   | -   | -    | -    | 2    | 1    | 1    |
| CO2    | 3   | 3   | 2    | 1   | -   | -   | -   | -   | -   | -    | -    | 2    | 1    | 1    |
| CO3    | 3   | 2   | 2    | -   | 1   | -   | -   | -   | -   | -    | -    | 3    | 2    | 1    |
| CO4    | 2   | 3   | 3    | 2   | 2   | -   | -   | -   | -   | -    | -    | 3    | 3    | 1    |
| Avg.   | 2.8 | 2.5 | 2.33 | 1.5 | 1.5 | -   | -   | -   | -   | -    | -    | 2.5  | 1.75 | 1    |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT<br>Level | CCE |     |     |     | ESE |     |     |     |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|
|             | CO1 | CO2 | CO3 | CO4 | CO1 | CO2 | CO3 | CO4 |
|             | 10  | 10  | 10  | 10  | 15  | 15  | 15  | 15  |
| L1          | —   | —   | —   | —   | —   | —   | —   | —   |
| L2          | √   | —   | —   | —   | √   | —   | —   | —   |
| L3          | —   | √   | √   | —   | —   | √   | √   | —   |
| L4          | —   | —   | —   | √   | —   | —   | —   | √   |
| L5          | —   | —   | —   | —   | —   | —   | —   | —   |
| L6          | —   | —   | —   | —   | —   | —   | —   | —   |

**This course serves as a prerequisite for maps with the following future courses:**

- Internet of Things (IoT)
- Computer Architecture and Organization
- Operating Systems
- Artificial Intelligence
- High Performance Computing
- Cyber-Physical Systems
- Machine Learning

### Job Mapping:

**Job/Future opportunities that one can get after learning this course:**

- Embedded Systems Engineer
- PIC Microcontroller Programmer
- IoT System Developer
- Robotics Engineer
- GPU Programmer
- Industrial Automation Engineer
- System Software Engineer
- Research and Higher Studies.



|                 |                   |          |                |                    |     |     |    |    |
|-----------------|-------------------|----------|----------------|--------------------|-----|-----|----|----|
| Program:        | S. Y. B. Tech: IT |          | Semester:      | IV                 |     |     |    |    |
| Course:         | Web Technologies  |          | Course Code:   | R25-IT-VEC-216     |     |     |    |    |
| Teaching Scheme |                   |          |                | Examination Scheme |     |     |    |    |
| Lecture         | Practical         | Tutorial | Credit (TH+PR) |                    | CCE | ESE | TW | PR |
| 01              | 02                | --       | 02             |                    | --  | --  | 25 | 25 |

**Course Description**

Web Application Development course introduces students to the fundamentals of web development technologies, covering both client-side and server-side programming. It focuses on building static and dynamic web pages using HTML, CSS, JavaScript, and jQuery, followed by an introduction to backend development using Node.js and Express.js. The course also provides basic exposure to modern frontend frameworks like React.js enabling students to understand full-stack web application development.

**Course Relevance:**

This course equips students with essential skills for modern web development by covering both client-side and server-side technologies. It is highly relevant to industry requirements, enabling learners to build dynamic, responsive, and database-driven web applications. The knowledge gained supports career opportunities in full stack development, software engineering, and web application design.

**Prerequisite:**

Basic knowledge of computers, Fundamentals of programming, understanding of web browsing

**Bridge Content: --****Course Objectives:**

1. To understand the fundamentals of web technologies (HTML, CSS, JavaScript)
2. To develop dynamic and interactive web pages
3. To introduce server-side programming using Node.js and Express.js.
4. To provide basic knowledge of modern frameworks like React.js

**Course Outcomes:** After learning the course, students will be able to

| <b>CO</b> | <b>Course Outcome</b>                                                                                                               | <b>Bloom's Level</b> |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| CO1       | <b>EXECUTE</b> static web page applications using HTML and CSS                                                                      | <b>3</b>             |
| CO2       | <b>IMPLEMENT</b> dynamic web applications using JavaScript and jQuery                                                               | <b>3</b>             |
| CO3       | <b>EXECUTE</b> basic server-side applications using Node.js and Express.js                                                          | <b>3</b>             |
| CO4       | <b>APPLY</b> modern frontend Functionalities for applications using ReactJS and perform basic database connectivity and operations. | <b>3</b>             |

**Course Contents**

|               |                                                  |               |            |
|---------------|--------------------------------------------------|---------------|------------|
| <b>Unit 1</b> | <b>Client-Side Web Development: HTML and CSS</b> | <b>3 Hrs.</b> | <b>CO1</b> |
|---------------|--------------------------------------------------|---------------|------------|

**HTML:** Getting started with HTML, Why HTML, Tags and Elements, Attributes, Properties, Headings list, Links. Tables, Images, HTML Form, Media (Audio, Video), Semantic HTML5 Elements.



|                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                       |               |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|---------------|------------|
| <b>CSS:</b> Why CSS, Types of CSS, how to use CSS, Properties, Classes, Child-Class (Nested CSS), Colors, Text, Background, Border, Margin, Padding, Positioning (flex, grid, inline, block), Animation, Transition.                                                                                                                                                                                                                         |                                                                       |               |            |
| <b>Exemplars/Case studies/Practical Applications and usage:</b> <ol style="list-style-type: none"> <li>1. College Website Development including department-wise information</li> <li>2. Responsive personal portfolio webpage using CSS styling techniques.</li> </ol>                                                                                                                                                                       |                                                                       |               |            |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Client-Side Web Development: JavaScript and JQuery</b>             | <b>4 Hrs.</b> | <b>CO2</b> |
| <b>JavaScript:</b> Introduction to JavaScript (JS), JS Variables and Constants, JS Variable Scopes, JS Data Types, JS Functions, JS Array, JS Object, JS Events, Form validation<br><br><b>JQuery:</b> Why JQuery, How to Use, Document Object Model (DOM) Manipulation with JQuery, Dynamic Content Change with JQuery, User Interface (UI) design using JQuery.                                                                            |                                                                       |               |            |
| <b>Exemplars/Case studies/Practical Applications and usage:</b> <ol style="list-style-type: none"> <li>1. Timer-based quizzes with automatic score generation.</li> <li>2. Quizzes to show/hide answers using slideToggle().</li> </ol>                                                                                                                                                                                                      |                                                                       |               |            |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Server-Side Web Development: Node JS and Express JS</b>            | <b>4 Hrs.</b> | <b>CO3</b> |
| <b>Node JS:</b> Introduction to Node JS, Node JS Process model, Installation of Node JS, Node JS event loop, Node JS Modules: Functions, Buffer, Module, Module Types, Module. Exports, Node Package Manager (NPM), Installing and updating packages<br><br><b>Express JS:</b> Introduction to Express JS, The MVC (Model -View-Controller) pattern, MVC in Web Frameworks, Routing, HTTP requests and responses, Middleware, Error handling |                                                                       |               |            |
| <b>Exemplars/Case studies/Practical Applications and usage:</b> <ol style="list-style-type: none"> <li>1. Simple server application handling multiple client request.</li> <li>2. Online Food Order Backend System: Handling orders, customers and menu APIs</li> </ol>                                                                                                                                                                      |                                                                       |               |            |
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Server-Side Web Development: ReactJS and Database Connectivity</b> | <b>4 Hrs.</b> | <b>CO4</b> |
| <b>React JS</b> Introduction to ReactJS, React Components, Inter Components Communication, Components Styling, Routing, Redux-Architecture, Hooks-Basic hooks, useState() hook, useEffect() hook useContext() hook.<br><br><b>Working with Databases:</b> Overview, Connection String, Configuring, Working with Select command, Various database operations                                                                                 |                                                                       |               |            |
| <b>Exemplars/Case studies/Practical Applications and usage:</b> <ol style="list-style-type: none"> <li>1. ReactJS application to Display student records using components.</li> <li>2. Weather Information Dashboard: Dynamically Fetching weather data using APIs</li> </ol>                                                                                                                                                                |                                                                       |               |            |
| <b>List of Practical:</b>                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                       |               |            |
| <b>Experiment No.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Design First Page of College Website Using HTML</b>                | <b>2 Hrs</b>  | <b>CO1</b> |

**Problem Statement**

Design the homepage of a college website using only HTML.

**Associated Tasks**

1. Create the basic structure of an HTML document.
2. Add a heading displaying the college name.
3. Create a navigation menu using hyperlinks.
4. Insert a welcome message/banner.
5. Add an “About College” paragraph.

**Exemplars and Utility:**

1. Header with college name
2. Navigation links: Home, About, Courses, Contact
3. Welcome message
4. About college information

|                        |                                           |              |            |
|------------------------|-------------------------------------------|--------------|------------|
| <b>Experiment No.2</b> | <b>Online Student Registration System</b> | <b>2 Hrs</b> | <b>CO1</b> |
|------------------------|-------------------------------------------|--------------|------------|

**Problem Statement:**

Develop an online student registration system using HTML and CSS.

**Associated Tasks:**

1. Design homepage layout using HTML tags.
2. Apply CSS styling for responsiveness.
3. Create navigation links between sections.
4. Add project gallery with hover effects.

**Exemplars and Utility:**

1. Design student registration form.
2. Display registered student records in table format.

|                        |                                     |              |            |
|------------------------|-------------------------------------|--------------|------------|
| <b>Experiment No.3</b> | <b>Interactive Quiz Application</b> | <b>2 Hrs</b> | <b>CO2</b> |
|------------------------|-------------------------------------|--------------|------------|

**Problem Statement**

Develop an interactive quiz application using JavaScript with timer functionality, score calculation, and dynamic result display.

**Associated Tasks:**

1. Create question database.
2. Design quiz interface.
3. Implement timer functionality.
4. Add navigation between questions.
5. Calculate and display score.
6. Generate result summary automatically.

**Exemplars and Utility:**

1. Create multiple-choice question interface.



2. Add countdown timer.
3. Calculate and display scores automatically.

|                        |                                                            |              |            |
|------------------------|------------------------------------------------------------|--------------|------------|
| <b>Experiment No.4</b> | <b>Client-Side Form Validation System Using JavaScript</b> | <b>2 Hrs</b> | <b>CO2</b> |
|------------------------|------------------------------------------------------------|--------------|------------|

**Problem Statement:**

To design and implement form validation using JavaScript to ensure correct user input before submission.

**Associated Tasks:**

1. Create login/registration form using HTML
2. Apply validation for fields (name, email, password, mobile)
3. Use regular expressions for validation.
4. Display error/success messages dynamically.

**Exemplars and Utility:**

1. Login form validation
2. Registration form with password strength check.
3. Ensures data accuracy, improves user experience, and reduces server-side processing.

|                        |                                  |              |            |
|------------------------|----------------------------------|--------------|------------|
| <b>Experiment No.5</b> | <b>Image Slider using jQuery</b> | <b>2 Hrs</b> | <b>CO2</b> |
|------------------------|----------------------------------|--------------|------------|

**Problem Statement:**

Develop an automatic image slider/gallery using jQuery animation effects.

**Associated Tasks:**

1. Create image gallery layout.
2. Add navigation buttons.
3. Implement slide transitions.
4. Add automatic slideshow timer.

**Exemplars and Utility:**

1. Create image slideshow.
2. Add next and previous buttons.

|                        |                           |              |            |
|------------------------|---------------------------|--------------|------------|
| <b>Experiment No.6</b> | <b>Create HTTP Server</b> | <b>2 Hrs</b> | <b>CO3</b> |
|------------------------|---------------------------|--------------|------------|

**Problem Statement**

Develop a basic web server using Node.js that displays a welcome message in the browser.

**Associated Tasks:**

1. Install Node.js.
2. Create server using http module.
3. Define server port number.
4. Send response to browser.
5. Run server using terminal.

**Exemplars and Utility:**



1. Create HTTP server.
2. Handle browser requests.
3. Send text response.

**Experiment No.7    Todo List application****2 Hrs****CO4****Problem Statement**

To develop a Todo List application using React that allows users to manage tasks by adding, updating, and deleting items dynamically.

**Associated Tasks:**

1. Create a React project using Create React App or Vite.
2. Design a user interface for adding and displaying tasks.
3. Implement functionality to add new tasks using React state.
4. Implement update and delete operations for existing tasks.
5. Display the list of tasks dynamically using React components

**Exemplars and Utility:**

1. **Task Management Application:** Demonstrates how users can manage daily tasks using add, update, and delete operations in a React application.
2. **Dynamic Web Application:** Helps students understand React concepts such as components, state management, and interactive UI development.

**Experiment No.8    Blogging Application****2 Hrs****CO4****Problem Statement**

Develop a simple blogging application using React.js with reusable components, props, and state management.

**Associated Tasks:**

1. Setup React project.
2. Create reusable components.
3. Implement props and state.
4. Add new blog functionality.
5. Display blogs dynamically.

**Exemplars and Utility:**

1. Create blog post components.
2. Add state management for posts.
3. Implement add/view/delete blog features.

**Experiment No.9    Web Application Deployment Using Cloud Platform****2 Hrs****CO4****Problem Statement:**

Deploy a full-stack web application using modern cloud deployment platforms.

**Associated Tasks:**



1. Create production build of application
2. Deploy frontend using Netlify/Vercel
3. Deploy backend using Render/Railway
4. Configure environment variables

**Exemplars and Utility:**

- Real-time web hosting
- Production deployment practices
- Industry-level deployment workflow

|                         |                                       |              |                           |
|-------------------------|---------------------------------------|--------------|---------------------------|
| <b>Experiment No.10</b> | <b>Mini Project (Perform Any one)</b> | <b>6 Hrs</b> | <b>CO1, CO2, CO3, CO4</b> |
|-------------------------|---------------------------------------|--------------|---------------------------|

Following are example statements based on real-world applications but not limited to:

**Mini Project 1: End-to-End E-Commerce Web Application**

**Problem Statement:** Design and develop an online shopping platform using HTML/CSS, JavaScript, React JS, Node JS, and Express JS that supports product browsing, user authentication, shopping cart management, order placement, payment gateway simulation, and transaction tracking. The system should demonstrate responsive design, secure checkout and modern web development practices.

**Mini Project 2: Smart Event Registration and Ticket Booking System**

**Problem Statement:** Develop a web-based event management platform using HTML/CSS, JavaScript, React JS, Node JS, and Express JS that enables users to browse events, register online, book tickets, manage seat availability, and receive booking confirmation. The system should include authentication, payment simulation, and responsive UI design.

**Mini Project 3: Job Portal and Resume Management System**

**Problem Statement:** Design and develop a job portal using HTML/CSS, JavaScript, React JS, Node JS, and Express JS where job seekers can create profiles, upload resumes, search job opportunities, and apply online. Employers should be able to post jobs and manage applications through an interactive dashboard.

**Mini Project 4: College Placement Management System**

**Problem Statement:** Develop a web application using HTML/CSS, JavaScript, React JS, Node JS, and Express JS that manages placement activities including student registration, company information, job postings, application tracking, and interview scheduling. The system should provide role-based access and reporting features.

**Textbooks:**

1. Jeffrey C. Jackson, Web Technologies: A Computer Science Perspective, Second Edition, 2007, Pearson Education, ISBN: 978-0131856035.



2. Robert W. Sebesta, Programming the World Wide Web, 8th Edition, 2014, Pearson Education, ISBN-10: 0133775984.

### Reference Books:

1. Marty Hall and Larry Brown, Core Web Programming, Second Edition, 2001, Pearson Education, ISBN: 978-0130897930.

2.H. M. Deitel, P. J. Deitel, and A. B. Goldberg, Internet & World Wide Web How to Program, Fifth Edition, 2015, Pearson Education, ISBN-10: 0132151006.

3.Chris Bates, Web Programming: Building Internet Applications, 3rd Edition, Wiley India, 2006, ISBN: 9780470017753.

4.Xue Bai et al., The Web Warrior Guide to Web Programming, Thomson/Course Technology, 2003, ISBN: 9780619064587.

### Website Links/ Online Resources

1. HTML: The Complete Reference: Thomas A. Powell

<http://www.htmlref.com/>

2.Web Technology: Dr. Ashutosh Kumar Bhatt, Uttarakhand Open University, Haldwani

[https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26\\_cs08](https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_cs08)

3.Introduction to Modern Application Development, Prof. Aamod Sane, IIT Madras

<https://nptel.ac.in/courses/106106222>

4.CSS: W3Schools CSS Tutorial

<https://www.w3schools.com/css/>

5.jQuery: Official jQuery Documentation

<https://jquery.com/>

6.Full Stack Web Development Resource (HTML, CSS, JavaScript, React, Node.js, Express.js)

<https://developer.mozilla.org/>

7. Mini-projects: Hackathon Project Ideas 2026

<https://unstop.com/blog/hackathon-project-ideas>

9. Mini-projects: DeveloperWeek 2024 Hackathon

<https://developerweek-2024-hackathon.devpost.com/>



| Strength of CO-PO-PSO Mapping |      |     |      |     |      |     |     |     |     |      |      |      |      |      |
|-------------------------------|------|-----|------|-----|------|-----|-----|-----|-----|------|------|------|------|------|
| CO                            | PO1  | PO2 | PO3  | PO4 | PO5  | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| CO1                           | 3    | 2   | 3    | 1   | 3    | -   | -   | -   | 1   | 2    | -    | 3    | 2    | 1    |
| CO2                           | 3    | 3   | 3    | 2   | 3    | -   | -   | -   | 2   | 2    | -    | 3    | 3    | 2    |
| CO3                           | 3    | 3   | 3    | 2   | 3    | -   | -   | -   | 2   | 2    | -    | 3    | 3    | 2    |
| CO4                           | 2    | 2   | 2    | 1   | 2    | -   | -   | -   | 1   | 1    | -    | 2    | 2    | 2    |
| Avg.                          | 2.75 | 2.5 | 2.75 | 1.5 | 2.75 | -   | -   | -   | 1.5 | 1.75 | -    | 2.75 | 2.50 | 1.75 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE based on ARCV |       |       |       |       |       |       |       |       |         |
|----------|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|---------|
|          | Exp 1             | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10  |
| CO       | CO1               | CO1   | CO2   | CO2   | CO2   | CO3   | CO4   | CO4   | CO4   | CO1-CO4 |
| L1       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -       |
| L2       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -       |
| L3       | ✓                 | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓       |
| L4       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -       |
| L5       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -       |
| L6       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -       |

**This course serves as a prerequisite for maps with the following future courses:**

- Advanced Web Development
- Full Stack Development
- Cloud Computing
- DevOps
- Mobile Application Development.
- Machine Learning Applications (Web-based)

### Job Mapping:

**Job/Future opportunities that one can get after learning this course:**

- Front-End Developer
- Back-End Developer
- Full Stack Developer
- Web Application Developer
- Node.js Developer
- JavaScript Developer
- API Developer



|                             |                                                       |          |                |                    |              |                |    |
|-----------------------------|-------------------------------------------------------|----------|----------------|--------------------|--------------|----------------|----|
| Program:                    | S. Y. B. Tech                                         |          |                |                    | Semester:    | IV             |    |
| Course:                     | Modern Indian Language and Technical Writing- Marathi |          |                |                    | Course Code: | R25-IT-AEC-217 |    |
| Teaching Scheme (Hrs./Week) |                                                       |          | Credit (TH+PR) | Examination Scheme |              |                |    |
| Lecture                     | Practical                                             | Tutorial |                | CCE                | ESE          | TW             | PR |
| 01                          | 02                                                    | --       | 02             | --                 | --           | 50             | -- |

**अभ्यासक्रम वर्णन (Course Description):**

हा अभ्यासक्रम आईटी विद्यार्थ्यांसाठी मराठी भाषेतील मूलभूत भाषिक कौशल्यांचा विकास करण्यासाठी तयार करण्यात आला आहे. या अभ्यासक्रमात श्रवण, संभाषण, वाचन आणि लेखन या कौशल्यांवर भर देण्यात आला आहे. तसेच डिजिटल माध्यमे, वेबसाईट, ब्लॉग, सोशल मीडिया यांसाठी मराठीत प्रभावी लेखन करण्याचे तंत्र विद्यार्थ्यांना शिकवले जाते. माहिती तंत्रज्ञान क्षेत्रातील तांत्रिक लेखन, दस्तऐवजीकरण, भाषांतर आणि व्यावसायिक संवाद यांचे मूलभूत ज्ञान या अभ्यासक्रमाद्वारे दिले जाते. यामुळे विद्यार्थ्यांना मराठी भाषेचा वापर व्यावसायिक, तांत्रिक आणि डिजिटल क्षेत्रात प्रभावीपणे करता येईल.

**अभ्यासक्रमाची उपयुक्तता (Course Relevance):**

आजच्या माहिती तंत्रज्ञानाच्या युगात प्रभावी संवाद आणि योग्य भाषिक कौशल्ये अत्यंत महत्वाची आहेत. माहिती तंत्रज्ञान क्षेत्रात काम करताना तांत्रिक माहिती सुस्पष्टपणे मांडणे, प्रकल्प अहवाल तयार करणे, ई-मेल आणि डिजिटल माध्यमांतून संवाद साधणे आवश्यक असते. या अभ्यासक्रमामुळे विद्यार्थ्यांना मराठी भाषेचा वापर तांत्रिक आणि व्यावसायिक संदर्भात करता येईल. तसेच डिजिटल माध्यमांमध्ये मराठी भाषेच्या वापराच्या वाढत्या संधी लक्षात घेता हा अभ्यासक्रम विद्यार्थ्यांच्या संवादकौशल्यांचा आणि व्यावसायिक क्षमतेचा विकास करण्यास उपयुक्त ठरतो.

**पूर्वअट (Prerequisite):**

या अभ्यासक्रमासाठी विद्यार्थ्यांना मराठी भाषेचे प्राथमिक ज्ञान असणे अपेक्षित आहे. विद्यार्थ्यांना मराठीत साधे वाचन, लेखन आणि संवाद साधण्याची मूलभूत क्षमता असावी. तसेच संगणक आणि इंटरनेटचा प्राथमिक वापर (जसे की ई-मेल, वेबसाईट, डिजिटल दस्तऐवज) यांचे मूलभूत ज्ञान असणे आवश्यक आहे.

**जोडणारा मजकूर (Bridge Content):**

ज्या विद्यार्थ्यांची मराठी भाषेतील पार्श्वभूमी मर्यादित आहे किंवा ज्यांना मराठीतील लेखन व संवाद कौशल्ये सुधारण्याची गरज आहे, त्यांच्यासाठी खालील विषयांचा आढावा दिला जाईल:

- १ मराठी भाषेची मूलभूत रचना आणि शुद्धलेखन
- २ मराठीतील मूलभूत वाचन आणि लेखन कौशल्ये
- ३ साधा मराठी संवाद आणि शब्दसंपत्तीचा विकास
- ४ संगणक व डिजिटल माध्यमांमध्ये मराठी टायपिंग आणि लेखन
- ५ डिजिटल संवादाचे प्राथमिक स्वरूप (ई-मेल, ऑनलाइन संदेश)

**अभ्यासक्रमाची उद्दिष्टे (Course Objectives):**



- विद्यार्थ्यांना मराठी भाषेच्या मूलभूत कौशल्यांची (श्रवण, संभाषण, वाचन, लेखन) ओळख करून देणे व त्यांचा प्रभावी वापर शिकवणे.
- डिजिटल आणि प्रसारमाध्यमांमध्ये मराठी भाषेचा योग्य व प्रभावी उपयोग करण्याची क्षमता विकसित करणे.
- आईटी क्षेत्राशी संबंधित तांत्रिक लेखन, भाषांतर व डिजिटल संवाद कौशल्ये विकसित करणे.
- व्यावसायिक व प्रशासकीय व्यवहारात मराठी भाषेचा वापर करण्याची क्षमता विद्यार्थ्यांमध्ये निर्माण करणे.
- विद्यार्थ्यांमध्ये सर्जनशील लेखन, संवाद कौशल्ये आणि माहिती सादरीकरणाची क्षमता वाढवणे.

**अभ्यासक्रमाची उद्दिष्ट्ये (Course Objectives):** हा अभ्यासक्रम शिकल्यानंतर, विद्यार्थी पुढील गोष्टी करण्यास सक्षम होतील:

| CO  | Course Outcome                                                                                                                                                                                                                           | Bloom's Level |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| CO1 | मराठी भाषेतील मूलभूत भाषिक कौशल्यांचा (श्रवण, संभाषण, वाचन व लेखन) प्रभावी वापर करून डिजिटल प्लॅटफॉर्मसाठी (ब्लॉग, सोशल मीडिया इ.) योग्य शैलीत प्रभावी लेखन तयार करणे तसेच मराठी टायपिंग टूल्सचा अभ्यास करून त्यांचा कुशलतेने वापर करणे. | ३             |
| CO2 | वेबसाईट, ब्लॉग आणि सोशल मीडिया यांसारख्या डिजिटल माध्यमांसाठी मराठीत प्रभावी लेखन करणे तसेच तांत्रिक दस्तऐवज, अहवाल आणि सॉफ्टवेअर संबंधित सामग्री विकसित करणे.                                                                           | ६             |
| CO3 | आईटी क्षेत्रातील तांत्रिक लेखन, दस्तऐवजीकरण, भाषांतर तसेच यूआई/यूएक्स मजकूर आणि व्यावसायिक संवाद (ई-मेल, ग्राहक संवाद) प्रभावीपणे तयार व सादर करण्याची कौशल्ये आत्मसात करणे.                                                             | ६             |
| CO4 | व्यावसायिक ई-मेल, अहवाल आणि प्रकल्पसंबंधित लेखन मराठीत तयार करणे तसेच इंग्रजी-मराठी भाषांतर व स्थानिकीकरण अचूकतेने विश्लेषण करून विकसित करणे.                                                                                            | ६             |

### Course Contents

| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | भाषा, संवाद आणि व्यक्तिमत्त्व विकास | 3 Hrs. | CO1 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------|-----|
| <ol style="list-style-type: none"> <li>भाषा आणि व्यक्तिमत्त्व विकास : सहसंबंध</li> <li>आधुनिक समाजातील संवादाचे महत्त्व</li> <li>व्यावसायिक जीवनात मराठी भाषेची भूमिका</li> <li>श्रवण, संभाषण, वाचन व लेखन ही भाषिक कौशल्ये</li> </ol> <p><b>उदाहरणे आणि व्यावहारिक उपयोगिता:</b></p> <ol style="list-style-type: none"> <li>भाषा व व्यक्तिमत्त्व विकास, आधुनिक संवादाचे महत्त्व, व्यावसायिक जीवनातील मराठी भाषेची भूमिका तसेच श्रवण, संभाषण, वाचन व लेखन या भाषिक कौशल्यांचा वापर करून मुलाखत, सादरीकरण, ई-मेल, अहवाल लेखन आणि ग्राहक संवाद प्रभावीपणे साधणे.</li> <li>कार्यालयीन संवाद व अहवाल लेखन – एखाद्या आयटी कंपनीतील प्रकल्पासाठी ग्राहकाला मराठीत औपचारिक ई-मेल लिहिणे, मीटिंगचा अहवाल तयार करणे आणि ग्राहक संवादाचे सादरीकरण करणे.</li> </ol> |                                     |        |     |



3. डिजिटल माध्यमांसाठी भाषिक कौशल्य प्रकल्प – स्थानिक व्यवसाय, महाविद्यालयीन कार्यक्रम किंवा सामाजिक विषयावर मराठीत ब्लॉग/सोशल मीडिया पोस्ट तयार करून गटचर्चा व मौखिक सादरीकरण करणे.

| Unit 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | डिजिटल माध्यमांसाठी मराठी लेखन       | 4 Hrs. | CO2 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------|-----|
| <p>१. वेबसाईट आणि ब्लॉगसाठी लेखन</p> <p>२. सोशल मीडिया लेखन (फेसबुक, ट्विटर, लिंकडइन)</p> <p>३. डिजिटल न्यूज आणि ऑनलाइन माहिती लेखन</p> <p>४. पॉडकास्ट, यूट्यूब आणि मल्टीमीडिया स्क्रिप्ट लेखन</p> <p><b>उदाहरणे आणि व्यावहारिक उपयोगिता:</b></p> <p>१. वेबसाईट, ब्लॉग, सोशल मीडिया, डिजिटल न्यूज तसेच पॉडकास्ट आणि यूट्यूब प्लॅटफॉर्मसाठी आकर्षक मराठी लेखन व स्क्रिप्ट तयार करून प्रभावी डिजिटल संवाद आणि माहिती प्रसारण करणे.</p> <p>२. स्थानिक व्यवसायासाठी डिजिटल प्रचार प्रकल्प – एखाद्या स्थानिक दुकान, स्टार्टअप किंवा रेस्टॉरंटसाठी मराठीत ब्लॉग, फेसबुक/इंस्टाग्राम पोस्ट आणि यूट्यूब व्हिडिओ स्क्रिप्ट तयार करणे.</p> <p>३. डिजिटल न्यूज आणि पॉडकास्ट निर्मिती – महाविद्यालयीन कार्यक्रम, सामाजिक विषय किंवा स्थानिक बातमीवर आधारित ऑनलाइन न्यूज लेख आणि ३-५ मिनिटांचा मराठी पॉडकास्ट/यूट्यूब स्क्रिप्ट तयार करून सादर करणे.</p> |                                      |        |     |
| Unit 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | आईटी क्षेत्रातील मराठी भाषिक कौशल्ये | 4 Hrs. | CO3 |
| <p>१. तांत्रिक लेखन</p> <p>२. सॉफ्टवेअर व ॲप दस्तऐवजीकरण</p> <p>३. यूआई / यूएक्स मजकूर लेखन</p> <p>४. मराठी टायपिंग टूल्स.</p> <p>५. इंग्रजी-मराठी भाषांतर आणि स्थानिकीकरण</p> <p><b>उदाहरणे आणि व्यावहारिक उपयोगिता:</b></p> <p>१. तांत्रिक लेखन, सॉफ्टवेअर व ॲप दस्तऐवजीकरण, यूआई/यूएक्स मजकूर लेखन, मराठी टायपिंग टूल्स तसेच इंग्रजी-मराठी भाषांतर व स्थानिकीकरणाच्या माध्यमातून डिजिटल उत्पादनांसाठी प्रभावी आणि वापरकर्ता-अनुकूल मराठी सामग्री विकसित करणे.</p> <p>२. मोबाइल ॲप स्थानिकीकरण प्रकल्प – एखाद्या मोबाइल ॲपचे मेनू, बटण मजकूर, सूचना आणि हेल्प सेक्शन इंग्रजीतून मराठीत भाषांतर करून यूआई/यूएक्स अनुकूल दस्तऐवजीकरण तयार करणे.</p> <p>३. सॉफ्टवेअर दस्तऐवजीकरण प्रकल्प-एखाद्या सॉफ्टवेअर किंवा वेबसाइटसाठी वापरकर्ता मार्गदर्शिका आणि इंस्टॉलेशन गाईड मराठीत तयार करून मराठी टायपिंग टूल्सचा वापर करणे.</p>                |                                      |        |     |
| Unit 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | व्यावसायिक व प्रशासकीय मराठी व्यवहार | 4 Hrs. | CO4 |



१. ई-मेल लेखन आणि डिजिटल पत्रव्यवहार
२. प्रकल्प अहवाल आणि तांत्रिक अहवाल लेखन
३. प्रेझेंटेशन व माहिती सादरीकरणासाठी लेखन
४. ग्राहक संवाद

**उदाहरणे आणि व्यावहारिक उपयोगिता:**

१. ई-मेल लेखन, डिजिटल पत्रव्यवहार, प्रकल्प व तांत्रिक अहवाल लेखन, प्रेझेंटेशन आणि ग्राहक संवाद यांच्या माध्यमातून व्यावसायिक माहिती प्रभावी, स्पष्ट आणि औपचारिक पद्धतीने सादर करणे.
२. कॉर्पोरेट संवाद प्रकल्प – एखाद्या आयटी कंपनीच्या प्रकल्पासाठी ग्राहकाला औपचारिक ई-मेल, प्रकल्प प्रगती अहवाल आणि प्रेझेंटेशन मराठीत तयार करणे.
३. ग्राहक सहाय्य व तांत्रिक दस्तऐवजीकरण प्रकल्प – उत्पादन/सेवेसाठी ग्राहकांच्या प्रश्नांना मराठीत ई-मेलद्वारे उत्तर देणे तसेच संबंधित तांत्रिक अहवाल आणि माहितीपत्रक तयार करणे.

**प्रात्यक्षिकांची यादी (List of Experiments):**

| Experiment No.1 | सॉफ्टवेअर टूल्स वापरून मराठी टायपिंग | 2 Hrs. | CO1 |
|-----------------|--------------------------------------|--------|-----|
|-----------------|--------------------------------------|--------|-----|

**अभ्यासक्रम उद्दिष्ट (Objectives):**

विद्यार्थ्यांना विविध मराठी टायपिंग टूल्सची माहिती करून देणे तसेच त्यांचा वापर करून मराठीत प्रभावी लेखन कौशल्य विकसित करणे.

**संबंधित कार्ये(Associated Tasks):**

१. वेगवेगळी ३ मराठी टायपिंग टूल्स डाउनलोड/इन्स्टॉल करून वापरा.
२. देश मराठी कीबोर्ड, गुगल इनपुट टूल्स, मराठी कीबोर्ड ऑनलाइन, मराठी कीबोर्ड
३. कोणतेही एक मराठी टायपिंग टूल वापरून मराठीत लेख तयार करा : उद्योजकता आणि स्टार्टअपसाठी संवाद कौशल्य

**उदाहरणे आणि उपयुक्तता(Exemplars & Utility):**

१. देश मराठी कीबोर्ड, गुगल इनपुट टूल्स, मराठी कीबोर्ड ऑनलाइन आणि मराठी कीबोर्ड ॲप यांच्या साहाय्याने मराठीत प्रभावी लेखन, जलद टायपिंग आणि शुद्धलेखन सुधारणा साध्य करता येते.
२. स्थानिक भाषेत माहिती तयार करणे सुलभ होते तसेच उद्योजकता, स्टार्टअप आणि व्यावसायिक क्षेत्रासाठी संवाद व डिजिटल कौशल्ये विकसित होण्यास मदत होते.

| Experiment No.2 | संवाद कौशल्य व व्यक्तिमत्त्व विकास कार्यशाळा | 2 Hrs. | CO1 |
|-----------------|----------------------------------------------|--------|-----|
|-----------------|----------------------------------------------|--------|-----|

**अभ्यासक्रम उद्दिष्ट (Objectives):**

विद्यार्थ्यांच्या संभाषण कौशल्यांचा आणि व्यक्तिमत्त्वातील आत्मविश्वासाचा विकास करणे.

**संबंधित कार्य(Associated Tasks):**

- स्व-परिचय
  - 2 मिनिटांचा मराठीत परिचय द्या
  - फोकस: स्पष्टता, आत्मविश्वास, शारीरिक भाषा
- भूमिका अभिनय
  - परिस्थिती: नोकरी मुलाखत / ग्राहक-सेवा संवाद
  - मराठीत शैक्षणिक तांत्रिक व्हिडिओ/पॉडकास्ट तयार करणे
  - आर्थिक नियोजन किंवा तत्सम विषयावर दोन विद्यार्थ्यांमधील संवाद (पॉडकास्ट स्वरूपात).
  - एका विद्यार्थ्याने मुलाखत घेणाऱ्याची भूमिका करावी आणि दुसऱ्या विद्यार्थ्याने मुलाखत देणाऱ्याची भूमिका करावी. याचा ऑडिओ पॉडकास्ट तयार करावा.
- समूहचर्चा / वादविवाद
  - खालील विषयांवर समूहचर्चा किंवा वादविवाद आयोजित करा
  - कृत्रिम बुद्धिमत्ता विरुद्ध मानवी बुद्धिमत्ता/सोशल मीडियाचा प्रभाव/ डिजिटल इंडिया
- अभिप्राय सत्र
  - शिक्षक व सहविद्यार्थ्यांकडून सुधारणा सुचना

**उदाहरणे आणि उपयुक्तता(Exemplars & Utility):**

१. आत्मविश्वासपूर्ण स्व-परिचय सादर करून स्पष्ट व प्रभावी मराठी संभाषण तसेच नोकरी मुलाखतीतील योग्य संवाद कौशल्य विकसित करता येते.
२. विद्यार्थ्यांचे संभाषण कौशल्य, व्यक्तिमत्त्व विकास आणि आत्मविश्वास वाढून सार्वजनिक बोलण्याची भीती कमी होते.

|                        |                                                      |               |            |
|------------------------|------------------------------------------------------|---------------|------------|
| <b>Experiment No.3</b> | <b>भाषिक कौशल्ये व व्यावसायिक मराठी वापर प्रकल्प</b> | <b>2 Hrs.</b> | <b>CO1</b> |
|------------------------|------------------------------------------------------|---------------|------------|

**अभ्यासक्रम उद्दिष्ट (Objectives) :**

श्रवण, संभाषण, वाचन, लेखन या चारही कौशल्यांचा व्यावहारिक वापर आणि व्यावसायिक मराठीत प्राविण्य मिळवणे.

**संबंधित कार्य(Associated Tasks):**

१. श्रवण कौशल्य
  - मराठी भाषण/ऑडिओ ऐकून त्याचा सारांश लिहा
२. वाचन कौशल्य
  - वर्तमानपत्रातील लेख वाचा
  - मुख्य मुद्दे ओळखा आणि चर्चा करा
३. लेखन कौशल्य
  - खालील विषयांवर मराठीत ई-मेल तयार करा:
  - रजा अर्ज/इंटरनशिप विनंती/तांत्रिक तक्रार

**उदाहरणे आणि उपयुक्तता(Exemplars & Utility):**

१. मराठी भाषण किंवा ऑडिओ ऐकून त्याचा सारांश लिहिणे, वर्तमानपत्रातील लेखातील मुख्य मुद्दे ओळखणे, वाचलेल्या विषयावर चर्चा करणे आणि रजा अर्जासाठी औपचारिक ई-मेल लिहिणे यांद्वारे भाषिक कौशल्यांचा विकास करता येतो.
२. वाचनातून शब्दसंग्रह व आकलनशक्ती वाढते, विश्लेषण क्षमता विकसित होते तसेच औपचारिक आणि व्यावसायिक ई-मेल लेखन कौशल्य सुधारते.

|                        |                                                           |               |             |
|------------------------|-----------------------------------------------------------|---------------|-------------|
| <b>Experiment No.4</b> | <b>डिजिटल कंटेंट लेखन प्रकल्प (ब्लॉग आणि सोशल मीडिया)</b> | <b>2 Hrs.</b> | <b>CO2.</b> |
|------------------------|-----------------------------------------------------------|---------------|-------------|

**अभ्यासक्रम उद्दिष्ट (Objectives) :**

वेबसाईट/ब्लॉग आणि सोशल मीडियासाठी प्रभावी, वाचकाभिमुख मराठी लेखन कौशल्य विकसित करणे.

**संबंधित कार्ये(Associated Tasks):**

१. ब्लॉग लेखन
  - ५००-७०० शब्दांचा लेख लिहा
  - विषय: तंत्रज्ञान, शिक्षण, आरोग्य, करिअर इ.
  - डिजिटल पेमेंट/ऑनलाइन सुरक्षा/डेटा गोपनीयता
२. सोशल मीडिया पोस्ट्स
  - एकाच विषयावर:
    - फेसबुक साठी सविस्तर पोस्ट
    - ट्विटरसाठी २८० अक्षरांतील संक्षिप्त पोस्ट
    - लिंकडइन साठी व्यावसायिक शैलीतील पोस्ट
३. हॅशटॅग रणनीती
  - योग्य ८-१० हॅशटॅग तयार करा

**उदाहरणे आणि उपयुक्तता(Exemplars & Utility):**

१. तंत्रज्ञान, शिक्षण, आरोग्य, करिअर, डिजिटल पेमेंट, ऑनलाइन सुरक्षा आणि डेटा गोपनीयता यांसारख्या विषयांवर ब्लॉग लेख, फेसबुक पोस्ट आणि ट्विटर साठी प्रभावी व आकर्षक मराठी मजकूर तयार करता येतो.
२. विद्यार्थ्यांचे डिजिटल लेखन कौशल्य विकसित होते, विविध सोशल मीडिया लेखनशैलीचे ज्ञान मिळते तसेच माहिती संक्षिप्त, वाचकाभिमुख आणि प्रभावीपणे मांडण्याची क्षमता वाढते.

|                        |                                             |               |            |
|------------------------|---------------------------------------------|---------------|------------|
| <b>Experiment No.5</b> | <b>डिजिटल मीडिया स्क्रिप्ट व न्यूज लेखन</b> | <b>2 Hrs.</b> | <b>CO2</b> |
|------------------------|---------------------------------------------|---------------|------------|

**अभ्यासक्रम उद्दिष्ट (Objectives):**

ऑनलाइन न्यूज, पॉडकास्ट आणि यूट्यूबसाठी स्क्रिप्ट लेखन कौशल्य विकसित करणे.

**संबंधित कार्ये(Associated Tasks):****१. डिजिटल न्यूज लेखन**

- ३००-४०० शब्दांची ऑनलाइन न्यूज स्टोरी लिहा
- रचना: शीर्षक, लीड, मुख्य भाग, निष्कर्ष
- स्पष्ट, वस्तुनिष्ठ आणि संक्षिप्त भाषा वापरा

**२. पॉडकास्ट स्क्रिप्ट लेखन**

- ३-५ मिनिटांचा पॉडकास्ट स्क्रिप्ट तयार करा
- घटक: प्रस्तावना, मुख्य भाग, निष्कर्ष

**३. यूट्यूब स्क्रिप्ट लेखन**

- ५ मिनिटांच्या व्हिडिओसाठी स्क्रिप्ट लिहा
- सुरुवात आकर्षक, मुख्य माहिती / विषयाचा भाग, प्रेक्षकांना कृती करण्याचे आवाहन (उदा. लाईक, शेअर, सबस्क्राइब)

**उदाहरणे आणि उपयुक्तता(Exemplars & Utility):**

- १ स्पष्ट आणि संक्षिप्त ऑनलाइन न्यूज स्टोरी, योग्य रचनेतील डिजिटल न्यूज तसेच ३-५ मिनिटांच्या पॉडकास्टसाठी प्रभावी स्क्रिप्ट तयार करून वस्तुनिष्ठ आणि माहितीपूर्ण डिजिटल मीडिया लेखन करता येते.
- २ विद्यार्थ्यांचे डिजिटल मीडिया लेखन कौशल्य विकसित होते, ऑनलाइन न्यूज, पॉडकास्ट आणि यूट्यूबसाठी व्यावसायिक कंटेंट तयार करता येतो तसेच माहिती अचूक, प्रभावी आणि प्रेक्षकाभिमुख पद्धतीने मांडण्याची क्षमता वाढते.

| Experiment No.6 | तांत्रिक लेखन व सॉफ्टवेअर दस्तऐवजीकरण प्रकल्प | 2 Hrs. | CO3 |
|-----------------|-----------------------------------------------|--------|-----|
|-----------------|-----------------------------------------------|--------|-----|

**अभ्यासक्रम उद्दिष्ट (Objectives) :**

माहिती तंत्रज्ञान क्षेत्रासाठी स्पष्ट, अचूक आणि वापरकर्ताकेंद्रित तांत्रिक लेखन कौशल्य विकसित करणे

**संबंधित कार्ये(Associated Tasks):****१. वापरकर्ता मार्गदर्शक**

- एखाद्या ॲप/सॉफ्टवेअरची (उदा. नोट्स ॲप, ई-लर्निंग प्लॅटफॉर्म) ५००-७०० शब्दांची मार्गदर्शिका तयार करा
- घटक: परिचय, फीचर्स, वापराची पायरी (स्टेप बाय स्टेप), वारंवार विचारले जाणारे प्रश्न

**२. प्रक्रिया दस्तऐवजीकरण**

- “खाते कसे करावे” किंवा “फाइल अपलोड प्रक्रिया” याचे टप्प्याटप्प्याने वर्णन
- क्रमांकित पद्धत, स्पष्ट सूचना, सोपी भाषा

**३. तांत्रिक संज्ञांची यादी**

- १५-२० माहिती तंत्रज्ञानाशी संबंधित मुद्दे / विषय संज्ञांची यादी तयार करा
- इंग्रजी शब्द + मराठी समतुल्य + थोडक्यात अर्थ

**उदाहरणे आणि उपयुक्तता(Exemplars & Utility):**



१. अॅप किंवा सॉफ्टवेअरची वापरकर्ता मार्गदर्शिका तयार करून त्यामध्ये परिचय, फीचर्स, वापराच्या पायऱ्या, प्रश्नसंच तसेच “खाते कसे तयार करावे” किंवा “फाइल अपलोड प्रक्रिया” यांसारख्या प्रक्रिया क्रमांकित पद्धतीने स्पष्टपणे मांडता येतात.
२. विद्यार्थ्यांचे तांत्रिक लेखन कौशल्य विकसित होते, माहिती अचूक व सुसंगत पद्धतीने सादर करता येते तसेच वापरकर्ता मार्गदर्शक आणि प्रक्रिया दस्तऐवजीकरण तयार करण्याचे कौशल्य प्राप्त होते.

|                        |                                                         |               |            |
|------------------------|---------------------------------------------------------|---------------|------------|
| <b>Experiment No.7</b> | <b>यूआई / यूएक्स लेखन व भाषांतर-स्थानिकीकरण प्रकल्प</b> | <b>2 Hrs.</b> | <b>CO3</b> |
|------------------------|---------------------------------------------------------|---------------|------------|

**अभ्यासक्रम उद्दिष्ट (Objectives):**

डिजिटल उत्पादनांसाठी (एप्स/वेबसाइटें) प्रभावी यूआई मजकूर आणि अचूक भाषांतर/स्थानिकीकरण कौशल्य विकसित करणे.

**संबंधित कार्ये(Associated Tasks):**

१. यूआई मजकूर लेखन
  - लॉगिन पृष्ठ, साइनअप फॉर्म, सेटिंग्ज पृष्ठसाठी मजकूर तयार करा
  - उदा. बटण मजकूर, सूचना, टूलटिप्स
२. यूएक्स लेखन (पुनर्लेखन कार्य)
  - दिलेला इंग्रजी यूआई मजकूर अधिक वापरकर्ताकेंद्रित मराठीत रूपांतरित करा
  - उदा. “सबमिट करा” ऐवजी अधिक स्पष्ट पर्याय
३. भाषांतर
  - १०-१२ वाक्यांचा इंग्रजी माहिती तंत्रज्ञान मजकूर मराठीत अनुवाद करा
  - अचूकता + संदर्भानुसार शब्द निवड

**उदाहरणे आणि उपयुक्तता(Exemplars & Utility):**

१. लॉगिन पृष्ठ, साइनअप फॉर्म, सेटिंग्ज पृष्ठ, बटण मजकूर, सूचना आणि टूलटिप्ससाठी वापरकर्त्यास समजेल असा स्पष्ट व प्रभावी यूआई/यूएक्स मजकूर तयार करून इंग्रजी शब्दांचे वापरकर्ताकेंद्रित मराठी पर्याय विकसित करता येतात.
२. विद्यार्थ्यांचे यूआई/यूएक्स लेखन, इंग्रजी-मराठी भाषांतर आणि स्थानिकीकरण कौशल्य विकसित होते तसेच डिजिटल उत्पादनांसाठी स्पष्ट, सोपी आणि वापरकर्ता केंद्रित भाषा वापरून “वापरकर्ता अनुभव” सुधारण्यास मदत होते.

|                        |                                          |               |            |
|------------------------|------------------------------------------|---------------|------------|
| <b>Experiment No.8</b> | <b>व्यावसायिक लेखन व अहवाल तयार करणे</b> | <b>2 Hrs.</b> | <b>CO4</b> |
|------------------------|------------------------------------------|---------------|------------|

**अभ्यासक्रम उद्दिष्ट (Objectives):**

कार्यालयीन व प्रशासकीय कामासाठी औपचारिक, स्पष्ट आणि परिणामकारक लेखन कौशल्य विकसित करणे.

**संबंधित कार्ये(Associated Tasks):**

१. ई-मेल लेखन
२. औपचारिक ई-मेल :मीटिंग शेड्यूल करण्यासाठी
३. औपचारिक ई-मेल :प्रोजेक्ट अपडेट देण्यासाठी

**४. डिजिटल पत्रव्यवहार**

- अधिकृत नोटीस/सूचना तयार करा (१००—१५० शब्द)
- स्पष्ट, संक्षिप्त आणि औपचारिक भाषा

**५. अहवाल लेखन**

- ६००—८०० शब्दांचा प्रकल्प/तांत्रिक अहवाल तयार करा
- रचना: प्रस्तावना, उद्दिष्टे, पद्धत, निष्कर्ष, शिफारसी

**उदाहरणे आणि उपयुक्तता(Exemplars & Utility):**

१. मीटिंग शेड्यूल, प्रोजेक्ट अपडेट, अधिकृत नोटीस आणि सूचना यांसाठी औपचारिक, स्पष्ट व व्यावसायिक ई-मेल तसेच परिणामकारक डिजिटल पत्रव्यवहार तयार करता येतो.
२. कार्यालयीन आणि प्रशासकीय संवाद प्रभावीपणे साधता येतो, औपचारिक ई-मेल व नोटीस लेखन कौशल्य विकसित होते तसेच माहिती अचूक, संक्षिप्त आणि योग्य रचनेत मांडण्याची क्षमता वाढते.

| Experiment No.9 | प्रेझेंटेशन (सादरीकरण) व ग्राहक संवाद कौशल्य | 2 Hrs. | CO4 |
|-----------------|----------------------------------------------|--------|-----|
|-----------------|----------------------------------------------|--------|-----|

**अभ्यासक्रम उद्दिष्ट (Objectives) :**

व्यावसायिक सादरीकरण क्षमता विकसित करणे.

**संबंधित कार्ये(Associated Tasks):**

- १ सादरीकरणासाठी मजकूर लेखन
  - ८—१० स्लाइड्ससाठी मजकूर तयार करा
  - विषय: “नवीन प्रोजेक्ट प्रस्ताव” / “उत्पादन सादरीकरण”
  - प्रत्येक स्लाइडसाठी मुद्देसूद बुलेट्स
- २ भाषण / सादरीकरण स्क्रिप्ट
  - ३—५ मिनिटांचे सादरीकरण स्क्रिप्ट लिहा
  - स्पष्ट रचना: प्रस्तावना, मुख्य मुद्दे, निष्कर्ष
- ३ ग्राहक संवाद
  - तक्रार निवारण
  - उत्पादन माहिती देणे
  - नम्र, व्यावसायिक आणि समाधानकारक भाषा वापर

**उदाहरणे आणि उपयुक्तता(Exemplars & Utility):**

१. “नवीन प्रोजेक्ट प्रस्ताव” किंवा “उत्पादन सादरीकरण” यांसाठी मुद्देसूद स्लाइड मजकूर, ३—५ मिनिटांचे सादरीकरण स्क्रिप्ट तसेच प्रस्तावना, मुख्य मुद्दे आणि निष्कर्ष यांची योग्य रचना वापरून प्रभावी प्रेझेंटेशन तयार करता येते.
२. विद्यार्थ्यांचे व्यावसायिक सादरीकरण आणि ग्राहक संवाद कौशल्य विकसित होते, माहिती आकर्षक व स्पष्टपणे मांडता येते तसेच



आत्मविश्वासाने भाषण, तक्रार निवारण आणि उत्पादन माहिती सादर करण्याची क्षमता वाढते.

| Experiment No.10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | लघु प्रकल्प (मिनी प्रोजेक्ट) | 6 Hrs. | CO4 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------|-----|
| <p>खालील पैकी कोणताही एक लघु प्रकल्प तयार करा. प्रकल्प तयार केल्यानंतर लिंकडइन किंवा स्वतःच्या ब्लॉग वर शेअर करा. लघु प्रकल्पा साठी प्रतिकात्मक उदाहरणे खालीलप्रमाणे:</p> <p><b>१. लघु प्रकल्प (मिनी प्रोजेक्ट): कृत्रिम बुद्धिमत्ता आधारित शिक्षण प्रणाली:</b><br/>या प्रकल्पामध्ये कृत्रिम बुद्धिमत्तेवर मराठीत अहवाल तयार करणे, त्यासंबंधित सादरीकरण बनवणे, तसेच कृत्रिम बुद्धिमत्ता (ए.आय.) आधारित मोबाईल ॲपची वापरकर्ता पुस्तिका तयार करणे अपेक्षित आहे. यासोबत भारतातील कृत्रिम बुद्धिमत्ता क्षेत्रातील स्टार्टअप्सचे सर्वेक्षणही करता येईल.</p> <p><b>२. लघु प्रकल्प (मिनी प्रोजेक्ट): सायबर सुरक्षा जागरूकता आणि डिजिटल संरक्षण प्रणाली:</b><br/>या प्रकल्पात सायबर सुरक्षेवरील सविस्तर अहवाल, सायबर हल्ल्यांपासून बचाव यावर सादरीकरण, ए.टी.एम. मशीन किंवा मोबाईल बँकिंग ॲपची कृत्रिम बुद्धिमत्ता (ए.आय.) आधारित वापरकर्ता पुस्तिका, तसेच सायबर सुरक्षा क्षेत्रातील नामांकित व्यक्ती व स्टार्टअप्सचे सर्वेक्षण समाविष्ट असेल.</p> <p><b>३. लघु प्रकल्प (मिनी प्रोजेक्ट): क्लाउड कॉम्प्युटिंग आणि आधुनिक शिक्षण व्यवस्थापन:</b><br/>या प्रकल्पात क्लाउड कॉम्प्युटिंग तंत्रज्ञानावर अहवाल, त्याचे फायदे व उपयोग यावरील सादरीकरण, कॉलेजसाठी उद्योग संसाधन नियोजन प्रणाली(ई.आर.पी सॉफ्टवेअर), प्रणालीची वापरकर्ता पुस्तिका, तसेच क्लाउड तंत्रज्ञान वापरणाऱ्या भारतीय स्टार्टअप्सचे सर्वेक्षण तयार करणे अपेक्षित आहे.</p> <p><b>४. लघु प्रकल्प (मिनी प्रोजेक्ट): उद्योन्मुख माहिती तंत्रज्ञानाचा समाज व उद्योगांवरील प्रभाव:</b><br/>या प्रकल्पात कृत्रिम बुद्धिमत्ता (ए.आय.), सायबर सुरक्षा आणि क्लाउड कॉम्प्युटिंग यांसारख्या उद्योन्मुख तंत्रज्ञानांचा अभ्यास करून ह्या तंत्रज्ञानाचा समाज व उद्योगांवरील प्रभाव याबाबतचा मराठीत अहवाल व सादरीकरण तयार करणे समाविष्ट असेल. तसेच कॉलेज वार्षिक स्नेहसंमेलन कार्यक्रमा साठी डिजिटल स्क्रिप्ट तयार करणे, सूत्रसंचालन करणे या बाबतचा व्हिडिओ चित्रीकरण सादरीकरण आणि १० नामांकित माजी विद्यार्थी सर्वेक्षण सादर करणे अपेक्षित आहे.</p> |                              |        |     |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |        |     |
| <p>१. व्यावहारिक मराठी – प्रा. डॉ. वसंत शेकडे व प्रा. डॉ. संजय नगरकर, शब्दालय प्रकाशन, आयएसबीएन: ९७८९३८५५२७०२९, २०१५</p> <p>२. व्यावहारिक मराठी भाषा – डॉ. शारदिनी मोहिते, स्नेहवर्धन प्रकाशन, २००८, आयएसबीएन: ८१-८९६३४-७६-३</p> <p>३. सुगम मराठी व्याकरण व लेखन – मोरा/म. रा. वाळिंबे, नितीन प्रकाशन, विविध आवृत्या (२०१३, २०२३, २०२६), आयएसबीएन: ८१८६१६९८०६</p> <p>४. माय मराठी – सुहास लिमये, जयवंत चुनेकर, मराठी मुंबई विद्यापीठ जर्मन विभाग / ग्रंथाली, २०१४, आयएसबीएन:</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                              |        |     |



९७८९३८४४७५०७९

५. व्यावहारिक मराठी – संजय नगरकर, शब्दालय प्रकाशन, आयएसबीएन: ९७८९३८५५२७०२९, २०१५

**Reference Books:**

१. मराठी-इंग्रजी शब्दकोश – ऑक्सफोर्ड / इतर मान्यवर प्रकाशन, ऑक्सफोर्ड यूनिवर्सिटी प्रेस, आयएसबीएन: ९७८०१९९४७६२७५, २०१७; नवीन आवृत्ती २०२४ मध्ये प्रकाशित
२. मराठी व्याकरण – म. रा. वालिंबे, नितीन प्रकाशन, नवीन आवृत्ती: फेब्रुवारी २०२६, आयएसबीएन: ८१८६१६९८०६
३. व्यावहारिक मराठी लेखन – डॉ. संजय नगरकर / डॉ. वसंत शेकडे, शब्दालय प्रकाशन, आयएसबीएन: ९७८९३८५५२७०२९, २०१५
४. प्रभावी संवाद कौशल्ये – डॉ. माधव कौतिक कदम (संपादक) / डॉ. आशा भागवत, अथर्वा प्रकाशन / डायमंड पब्लिकेशन्स, आयएसबीएन: ९७८९३६१८६२४९६ (२०२५), आयएसबीएन: ९७८९३८६४०१४०३ (२०१८)
५. डिजिटल माध्यमांसाठी लेखन – डॉ. सदानंद गोपाळ / अॅड. लखनसिंह कटरे, शैक्षणिक जर्नल्स / विविध प्रकाशन, संशोधन लेख व संदर्भग्रंथ, २०२५

**Strength of CO-PO-PSO Mapping**

| CO  | PO1  | PO2  | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|------|------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 2    | 2    | 2   | 1   | 1   | 2   | -   | -   | 2   | 2    | -    | 2    | 1    | 1    |
| CO2 | 3    | 3    | 3   | 2   | 3   | 1   | -   | -   | 2   | 3    | -    | 3    | 2    | 2    |
| CO3 | 2    | 2    | 3   | 2   | 2   | 2   | -   | -   | 3   | 3    | -    | 2    | 3    | 2    |
| CO4 | 2    | 2    | 2   | 1   | 2   | 3   | -   | -   | 3   | 3    | -    | 2    | 2    | 3    |
| Avg | 2.25 | 2.25 | 2.5 | 1.5 | 2.0 | 2.0 | -   | -   | 2.5 | 2.75 | -    | 2.25 | 2.0  | 2.0  |

**Assessment Pattern**

| BT Level | CCE based on ARCV |       |       |       |       |       |       |       |       |        |
|----------|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
|          | Exp 1             | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10 |
| CO       | CO1               | CO1   | CO1   | CO2   | CO2   | CO3   | CO3   | CO4   | CO4   | CO4    |
| L1       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |
| L2       | ✓                 | ✓     | ✓     | -     | -     | -     | -     | -     | -     | -      |
| L3       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |
| L4       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |
| L5       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |
| L6       | -                 | -     | -     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓      |

हा अभ्यासक्रम पुढील प्रगत अभ्यासक्रमांसाठी पायाभूत म्हणून कार्य करतो:

- प्रगत तांत्रिक लेखन व सॉफ्टवेअर दस्तऐवजीकरण.



- ब्लॉग, सोशल मीडिया, एसईओ व डिजिटल ब्रँडिंग.
- वापरकर्ता इंटरफेस ,वापरकर्ता अनुभव साठी मजकूर लेखन.
- बहुभाषिक कंटेंट व माहिती तंत्रज्ञान स्थानिकीकरण
- व्यावसायिक ई-मेल, अहवाल, प्रेझेंटेशन कौशल्य
- डिजिटल न्यूज, स्क्रिप्ट लेखन, मल्टिमीडिया कंटेंट.

### नोकरी मॅपिंग (Job Mapping)

हा अभ्यासक्रम पूर्ण केल्यानंतर विद्यार्थ्यांना विविध क्षेत्रांमध्ये करिअरच्या संधी उपलब्ध होतात.

- कंटेंट रायटिंग व डिजिटल मीडिया वेबसाईट, ब्लॉग, सोशल मीडिया प्लॅटफॉर्मसाठी लेखन व संपादन.
- आईटी व तांत्रिक लेखन सॉफ्टवेअर दस्तऐवजीकरण, युजर मॅन्युअल्स, तांत्रिक रिपोर्ट्स.
- भाषांतर व लोकेलायझेशन मराठी-इंग्रजी अनुवाद, स्थानिक भाषांमध्ये कंटेंट रूपांतर.
- कॉर्पोरेट व प्रशासकीय भूमिका ई-मेल लेखन, अहवाल तयार करणे, प्रकल्प दस्तऐवजीकरण.
- मीडिया व संवाद पत्रकारिता, जनसंपर्क, प्रसारमाध्यमे व जाहिरात क्षेत्र.
- फ्रीलान्सिंग व उद्योजकता स्वतंत्र लेखक, ब्लॉगर्स, डिजिटल कंटेंट क्रिएटर्स.



|                 |                                                     |          |                   |                    |              |    |                |  |
|-----------------|-----------------------------------------------------|----------|-------------------|--------------------|--------------|----|----------------|--|
| Program:        | S. Y. B. Tech                                       |          |                   |                    | Semester:    |    | IV             |  |
| Course:         | Modern Indian Language and Technical Writing- Hindi |          |                   |                    | Course Code: |    | R25-IT-AEC-217 |  |
| Teaching Scheme |                                                     |          | Credit<br>(TH+PR) | Examination Scheme |              |    |                |  |
| Lecture         | Practical                                           | Tutorial |                   | CCE                | ESE          | TW | PR             |  |
| 1               | 02                                                  | --       | 02                | --                 | --           | 50 | --             |  |

**पाठ्यक्रम विवरण (Course Description):**

यह पाठ्यक्रम आईटी इंजीनियरिंग छात्रों के लिए हिंदी भाषा के मूलभूत तथा व्यावसायिक कौशलों के विकास हेतु बनाया गया है। इसमें सुनना, बोलना, पढ़ना और लिखना जैसे भाषाई कौशलों के साथ-साथ डिजिटल माध्यमों (वेबसाइट, ब्लॉग, सोशल मीडिया) के लिए प्रभावी हिंदी लेखन सिखाया जाएगा। इसके अतिरिक्त तकनीकी लेखन, रिपोर्ट लेखन, अनुवाद तथा व्यावसायिक संचार पर भी ध्यान दिया जाएगा।

**पाठ्यक्रम की प्रासंगिकता (Course Relevance)**

आज के सूचना प्रौद्योगिकी युग में प्रभावी संचार और उचित भाषाई कौशल अत्यंत आवश्यक हैं। आईटी क्षेत्र में कार्य करते समय तकनीकी जानकारी को स्पष्ट रूप से प्रस्तुत करना, परियोजना रिपोर्ट तैयार करना, ई-मेल लिखना तथा डिजिटल माध्यमों के जरिए संवाद करना अनिवार्य होता है। इस पाठ्यक्रम के माध्यम से छात्रों को हिंदी भाषा का उपयोग तकनीकी और व्यावसायिक संदर्भों में प्रभावी रूप से करने की क्षमता प्राप्त होगी। साथ ही, डिजिटल माध्यमों में हिंदी भाषा के बढ़ते उपयोग और अवसरों को ध्यान में रखते हुए यह पाठ्यक्रम छात्रों के संचार कौशल और व्यावसायिक दक्षता के विकास में सहायक सिद्ध होगा।

**पूर्व आवश्यकताएँ (Prerequisite)**

इस पाठ्यक्रम के लिए छात्रों को हिंदी भाषा का प्राथमिक ज्ञान होना अपेक्षित है। छात्रों में हिंदी में सरल वाचन, लेखन तथा संवाद करने की मूलभूत क्षमता होनी चाहिए। साथ ही, कंप्यूटर और इंटरनेट के प्राथमिक उपयोग (जैसे ई-मेल, वेबसाइट, डिजिटल दस्तावेज आदि) का बुनियादी ज्ञान होना आवश्यक है।

**ब्रिज कोर्स सामग्री (Bridge Content)**

जिन छात्रों की हिंदी भाषा में पृष्ठभूमि सीमित है या जिन्हें हिंदी में लेखन एवं संचार कौशल सुधारने की आवश्यकता है, उनके लिए निम्नलिखित विषयों का पुनरावलोकन कराया जाएगा:

- हिंदी भाषा की मूल संरचना एवं शुद्ध लेखन (वर्तनी)
- हिंदी में बुनियादी पठन और लेखन कौशल
- सरल हिंदी संवाद एवं शब्दावली का विकास
- कंप्यूटर और डिजिटल माध्यमों में हिंदी टाइपिंग एवं लेखन
- डिजिटल संचार के प्राथमिक रूप (ई-मेल, ऑनलाइन संदेश)

**पाठ्यक्रम के उद्देश्य (Course Objectives)**

- छात्रों को हिंदी भाषा के मूलभूत कौशलों (श्रवण, बोलना, पठन, लेखन) से परिचित कराना तथा उनका प्रभावी उपयोग सिखाना।
- डिजिटल और प्रसार माध्यमों में हिंदी भाषा का सही एवं प्रभावी उपयोग करने की क्षमता विकसित करना।
- आईटी क्षेत्र से संबंधित तकनीकी लेखन, अनुवाद तथा डिजिटल संचार कौशल विकसित करना।



४. व्यावसायिक एवं प्रशासनिक कार्यों में हिंदी भाषा के उपयोग की क्षमता विकसित करना।
५. छात्रों में रचनात्मक लेखन, संचार कौशल और सूचना प्रस्तुतीकरण की क्षमता बढ़ाना।

**Course Outcomes:** After learning the course, students will be able to

| CO  | Course Outcome                                                                                                                                                                                                                                          | Bloom's Level |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| CO1 | हिंदी भाषा के मूलभूत भाषाई कौशलों (सुनना, बातचीत, पढ़ना और लिखना) का प्रभावी उपयोग करके डिजिटल प्लेटफॉर्म (ब्लॉग, सोशल मीडिया आदि) के लिए उपयुक्त शैली में प्रभावी लेखन तैयार करना तथा हिंदी टाइपिंग टूल्स का अध्ययन करके उनका कुशलतापूर्वक उपयोग करना। | ३             |
| CO2 | वेबसाइट, ब्लॉग और सोशल मीडिया जैसे डिजिटल माध्यमों के लिए हिंदी में प्रभावी लेखन करना तथा तकनीकी दस्तावेज़, रिपोर्ट और सॉफ्टवेयर संबंधित सामग्री विकसित करना।                                                                                           | ६             |
| CO3 | आईटी क्षेत्र में तकनीकी लेखन, दस्तावेज़ीकरण, अनुवाद साथ ही यूआई/यूएक्स सामग्री और व्यावसायिक संवाद (ई-मेल, ग्राहक संवाद) प्रभावी ढंग से तैयार और प्रस्तुत करने का कौशल हासिल करना।                                                                      | ६             |
| CO4 | व्यावसायिक ई-मेल, रिपोर्ट और प्रोजेक्ट-संबंधित लेखन हिंदी में तैयार करना तथा अंग्रेज़ी-हिंदी अनुवाद और स्थानीयकरण को सटीकता से विश्लेषण करके विकसित करना।                                                                                               | ६             |

### Course Contents

| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | भाषा, संचार और व्यक्तित्व विकास   | 3 Hrs. | CO1 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------|-----|
| <ol style="list-style-type: none"> <li>१. भाषा और व्यक्तित्व विकास : संबंध</li> <li>२. आधुनिक समाज में संचार का महत्व</li> <li>३. व्यावसायिक जीवन में हिंदी भाषा की भूमिका</li> <li>४. श्रवण, बोलना, पठन और लेखन – ये भाषाई कौशल</li> </ol> <p><b>उदाहरण एवं व्यवहारिक उपयोगिता:</b></p> <ol style="list-style-type: none"> <li>१. भाषा और व्यक्तित्व विकास, आधुनिक संवाद का महत्व, व्यावसायिक जीवन में हिंदी भाषा की भूमिका तथा सुनना, बातचीत, पढ़ना और लिखने जैसी भाषाई कौशल का उपयोग करके साक्षात्कार, प्रस्तुति, ई-मेल, रिपोर्ट लेखन और ग्राहक संवाद प्रभावी ढंग से साधना।</li> <li>२. कार्यालयीन संवाद और रिपोर्ट लेखन – किसी आईटी कंपनी के प्रोजेक्ट के लिए ग्राहक को हिंदी में औपचारिक ई-मेल लिखना, मीटिंग की रिपोर्ट तैयार करना और ग्राहक संवाद का प्रस्तुतीकरण करना।</li> <li>३. डिजिटल माध्यमों के लिए भाषाई कौशल प्रोजेक्ट – स्थानीय व्यवसाय, कॉलेज कार्यक्रम या सामाजिक विषय पर हिंदी में ब्लॉग/सोशल मीडिया पोस्ट तैयार करके समूह चर्चा और मौखिक प्रस्तुतीकरण करना।</li> </ol> |                                   |        |     |
| Unit 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | डिजिटल माध्यमों के लिए हिंदी लेखन | 4 Hrs. | CO2 |



- १ वेबसाइट और ब्लॉग के लिए लेखन
- २ सोशल मीडिया लेखन (फेसबुक, ट्विटर, लिंकडइन)
- ३ डिजिटल समाचार और ऑनलाइन सूचना लेखन
- ४ पॉडकास्ट, यूट्यूब और मल्टीमीडिया स्क्रिप्ट लेखन

**उदाहरण एवं व्यवहारिक उपयोगिता:**

१. वेबसाइट, ब्लॉग, सोशल मीडिया, डिजिटल न्यूज तथा पॉडकास्ट और यूट्यूब प्लेटफॉर्म के लिए आकर्षक हिंदी लेखन और स्क्रिप्ट तैयार करके प्रभावी डिजिटल संवाद और जानकारी का प्रसारण करना।

२. स्थानीय व्यवसाय के लिए डिजिटल प्रचार परियोजना – किसी स्थानीय दुकान, स्टार्टअप या रेस्टोरेंट के लिए हिंदी ब्लॉग, फेसबुक/इंस्टाग्राम पोस्ट और यूट्यूब वीडियो स्क्रिप्ट तैयार करना।

३. डिजिटल न्यूज और पॉडकास्ट निर्माण – कॉलेज कार्यक्रम, सामाजिक विषय या स्थानीय खबर पर आधारित ऑनलाइन न्यूज आर्टिकल और ३-५ मिनट का हिंदी पॉडकास्ट/यूट्यूब स्क्रिप्ट तैयार करके प्रस्तुत करना।

| Unit 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | आईटी क्षेत्र में हिंदी भाषा कौशल      | 4 Hrs. | CO3 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------|-----|
| <ol style="list-style-type: none"> <li>१ तकनीकी लेखन</li> <li>२ सॉफ्टवेयर एवं ऐप दस्तावेजीकरण</li> <li>३ यूआई / यूएक्स सामग्री लेखन</li> <li>४ अंग्रेजी-हिंदी अनुवाद और स्थानीयकरण</li> </ol> <p><b>उदाहरण एवं व्यवहारिक उपयोगिता:</b></p> <ol style="list-style-type: none"> <li>१. तकनीकी लेखन, सॉफ्टवेयर और ऐप दस्तावेजीकरण, यूआई/यूएक्स पाठ लेखन, हिंदी टाइपिंग टूल्स तथा अंग्रेजी-हिंदी अनुवाद और स्थानीयकरण के माध्यम से डिजिटल उत्पादों के लिए प्रभावी और उपयोगकर्ता-अनुकूल हिंदी सामग्री विकसित करना।</li> <li>२. मोबाइल ऐप स्थानीयकरण परियोजना – किसी मोबाइल ऐप के मेनू, बटन पाठ, सूचनाएं और हेल्प सेक्शन को अंग्रेजी से हिंदी में अनुवाद करके यूआई/यूएक्स अनुकूल दस्तावेज तैयार करना।</li> <li>३. सॉफ्टवेयर दस्तावेज परियोजना – किसी सॉफ्टवेयर या वेबसाइट के लिए उपयोगकर्ता मार्गदर्शिका, प्रश्न संच और इंस्टॉलेशन गाइड हिंदी में तैयार करके हिंदी टाइपिंग टूल्स का उपयोग करना।</li> <li>४.</li> </ol> |                                       |        |     |
| Unit 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | व्यावसायिक एवं प्रशासनिक भाषा व्यवहार | 4 Hrs. | CO4 |
| <ol style="list-style-type: none"> <li>१. ई-मेल लेखन और डिजिटल पत्राचार</li> <li>२. परियोजना रिपोर्ट और तकनीकी रिपोर्ट लेखन</li> <li>३. प्रस्तुतीकरण एवं सूचना प्रस्तुत करने के लिए लेखन</li> <li>४. ग्राहक संवाद</li> </ol> <p><b>उदाहरण एवं व्यवहारिक उपयोगिता:</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                       |        |     |



- ई-मेल लेखन, डिजिटल पत्राचार, परियोजना और तकनीकी रिपोर्ट लेखन, प्रस्तुति और ग्राहक संवाद के माध्यम से व्यावसायिक जानकारी प्रभावी, स्पष्ट और औपचारिक तरीके से प्रस्तुत करना।
- कॉर्पोरेट संचार परियोजना – किसी आईटी कंपनी की परियोजना के लिए ग्राहक को औपचारिक ई-मेल, परियोजना प्रगति रिपोर्ट और प्रस्तुति हिंदी में तैयार करना।
- ग्राहक सहायता और तकनीकी दस्तावेजीकरण परियोजना – उत्पाद/सेवा के लिए ग्राहकों के प्रश्नों का हिंदी में ई-मेल के माध्यम से उत्तर देना तथा संबंधित तकनीकी रिपोर्ट और सूचना पत्र तैयार करना।

### List of Practical (प्रैक्टिकल की सूची):

| Experiment No.1 | सॉफ्टवेयर टूल्स का इस्तेमाल करके हिंदी टाइपिंग | 2 Hrs | CO1 |
|-----------------|------------------------------------------------|-------|-----|
|-----------------|------------------------------------------------|-------|-----|

#### मकसद (Objectives):

स्टूडेंट्स को अलग-अलग मराठी टाइपिंग टूल्स से प्रस्तुत कराना और उनका इस्तेमाल करके मराठी में अच्छी राइटिंग स्किल्स डेवलप करना।

#### संबंधित कार्य(Associated Tasks):

- अलग-अलग ३ हिंदी टाइपिंग टूल डाउनलोड/इंस्टॉल करें और इस्तेमाल करें।
- हिंदीएप हिंदी टाइपिंग टूल, इंडिक इनपुट, इंडिया टाइपिंग हिंदी टूल,
- किसी भी हिंदी टाइपिंग टूल का इस्तेमाल करके हिंदी में आर्टिकल बनाएं:  
विषय: एंटरप्रेन्योरशिप और स्टार्टअप्स के लिए कम्युनिकेशन स्किल्स

#### उदाहरण एवं उपयोगिता (Exemplars & Utility):

- कार्यालयीन संवाद और रिपोर्ट लेखन – किसी आईटी कंपनी की परियोजना के लिए ग्राहक को हिंदी में औपचारिक ई-मेल लिखना, मीटिंग का रिपोर्ट तैयार करना और ग्राहक संवाद का प्रस्तुतिकरण करना।
- डिजिटल माध्यमों के लिए भाषाई कौशल परियोजना – स्थानीय व्यवसाय, कॉलेज के कार्यक्रम या सामाजिक विषय पर हिंदी में ब्लॉग/सोशल मीडिया पोस्ट तैयार करके समूह चर्चा और मौखिक प्रस्तुतिकरण करना।

| Experiment No.2 | संप्रेषण कौशल एवं व्यक्तित्व विकास कार्यशाला | 2 Hrs | CO1 |
|-----------------|----------------------------------------------|-------|-----|
|-----------------|----------------------------------------------|-------|-----|

#### मकसद (Objectives):

विद्यार्थियों के संवाद कौशल एवं व्यक्तित्व में आत्मविश्वास का विकास करना।

#### संबंधित कार्य(Associated Tasks):

##### १. स्व-परिचय

- २ मिनट का हिंदी में परिचय दें
- ध्यान दें: स्पष्टता, आत्मविश्वास एवं शारीरिक भाषा

**२. भूमिका-अभिनय**

- परिस्थितियाँ: नौकरी साक्षात्कार / ग्राहक सेवा संवाद
- हिंदी एजुकेशनल टेक्निकल वीडियो/पॉडकास्ट बनाना
- फाइनेंशियल प्लानिंग या ऐसे ही किसी टॉपिक पर दो स्टूडेंट्स के बीच बातचीत (पॉडकास्ट फॉर्मेट में)।
- एक स्टूडेंट को इंटरव्यू लेने वाले का रोल निभाना चाहिए और दूसरे स्टूडेंट को इंटरव्यू देने वाले का रोल निभाना चाहिए। इसका एक ऑडियो पॉडकास्ट बनाया जाना चाहिए।

**३. समूह चर्चा**

- निम्नलिखित विषयों पर समूह चर्चा या वाद-विवाद का आयोजन करें:
- एआई विरुद्ध मानव बुद्धिमत्ता/सोशल मीडिया का प्रभाव/डिजिटल इंडिया

**४. प्रतिक्रिया सत्र**

- शिक्षक एवं सहपाठियों से सुधार हेतु सुझाव प्राप्त करें

**उदाहरण एवं उपयोगिता (Exemplars & Utility):**

१. आत्मविश्वासपूर्ण स्व-परिचय प्रस्तुत करके स्पष्ट और प्रभावी हिंदी संवाद तथा नौकरी के इंटरव्यू में उचित संवाद कौशल विकसित किया जा सकता है।

२. विद्यार्थियों का संवाद कौशल, व्यक्तित्व विकास और आत्मविश्वास बढ़कर सार्वजनिक बोलने का डर कम होता है।

| Experiment No.3 | भाषा कौशल एवं व्यावसायिक हिंदी उपयोग परियोजना | 2 Hrs | CO1 |
|-----------------|-----------------------------------------------|-------|-----|
|-----------------|-----------------------------------------------|-------|-----|

**मकसद (Objectives):**

श्रवण, बोलना, पढ़ना और लेखन-इन चारों भाषा कौशलों का व्यावहारिक उपयोग करते हुए व्यावसायिक हिंदी में प्रवीणता प्राप्त करना।

**संबंधित कार्य (Associated Tasks):****१. श्रवण कौशल**

- हिंदी भाषण/ऑडियो सुनकर उसका सारांश लिखें

**२. पठन कौशल**

- समाचारपत्र का लेख पढ़ें
- मुख्य बिंदुओं की पहचान करें और चर्चा करें

**३. लेखन कौशल**

- इन टॉपिक पर हिंदी में ई-मेल तैयार करें:
- छुट्टी का आवेदन/इंटरनशिप निवेदन/तकनीकी समस्या संबंधी शिकायत

**उदाहरण एवं उपयोगिता (Exemplars & Utility):**

1. हिंदी भाषण या ऑडियो सुनकर उसका सारांश लिखना, खबर के लेख के मुख्य बिंदु पहचानना, पढ़े हुए विषय पर चर्चा करना और छुट्टी के आवेदन के लिए औपचारिक ई-मेल लिखना आदि के माध्यम से भाषाई कौशल का विकास किया जा सकता है।



2. पठन से शब्दावली और समझने की क्षमता बढ़ती है, विश्लेषण क्षमता विकसित होती है और औपचारिक तथा व्यावसायिक ई-मेल लेखन कौशल में सुधार होता है।

| Experiment No.4 | डिजिटल कंटेंट लेखन परियोजना (ब्लॉग एवं सोशल मीडिया) | 2 Hrs | CO2 |
|-----------------|-----------------------------------------------------|-------|-----|
|-----------------|-----------------------------------------------------|-------|-----|

#### मकसद (Objectives):

वेबसाइट/ब्लॉग एवं सोशल मीडिया के लिए प्रभावी, पाठक-केंद्रित हिंदी लेखन कौशल विकसित करना

#### संबंधित कार्य(Associated Tasks):

##### १. ब्लॉग लेखन

- ५००-७०० शब्दों का लेख लिखें
- विषय: तकनीक, शिक्षा, स्वास्थ्य, करियर आदि
- डिजिटल भुगतान/ऑनलाइन सुरक्षा/डेटा गोपनीयता

##### २. सोशल मीडिया पोस्ट

- एक ही विषय पर:
  - फेसबुक के लिए विस्तृत पोस्ट
  - ट्विटर के लिए २८० अक्षरों में संक्षिप्त पोस्ट
  - लिंकडइन के लिए पेशेवर शैली में पोस्ट

##### ३. हैशटैग रणनीति

- ८-१० उपयुक्त हैशटैग तैयार करें
- हिंदी + अंग्रेजी का मिश्रण उपयोग कर सकते हैं

#### उदाहरण एवं उपयोगिता (Exemplars & Utility):

१. तकनीक, शिक्षा, स्वास्थ्य, करियर, डिजिटल पेमेंट, ऑनलाइन सुरक्षा और डेटा गोपनीयता जैसे विषयों पर ब्लॉग लेख, फेसबुक पोस्ट और ट्विटर के लिए प्रभावशाली और आकर्षक हिंदी सामग्री तैयार की जा सकती है।

२. छात्रों का डिजिटल लेखन कौशल विकसित होता है, विभिन्न सोशल मीडिया लेखन शैलियों का ज्ञान प्राप्त होता है और जानकारी को संक्षिप्त, पाठक-केंद्रित और प्रभावी ढंग से प्रस्तुत करने की क्षमता बढ़ती है।

| Experiment No.5 | डिजिटल मीडिया स्क्रिप्ट एवं समाचार लेखन | 2 Hrs | CO2 |
|-----------------|-----------------------------------------|-------|-----|
|-----------------|-----------------------------------------|-------|-----|

#### मकसद (Objectives):

ऑनलाइन समाचार, पॉडकास्ट और यूट्यूब के लिए स्क्रिप्ट लेखन कौशल विकसित करना।

#### संबंधित कार्य(Associated Tasks):

##### १. डिजिटल समाचार लेखन



- ३००–४०० शब्दों की ऑनलाइन समाचार स्टोरी लिखें
- संरचना: शीर्षक, मुख्य अंश, मुख्य भाग, निष्कर्ष
- स्पष्ट, वस्तुनिष्ठ एवं संक्षिप्त भाषा का उपयोग करें

## २. पॉडकास्ट स्क्रिप्ट लेखन

- ३–५ मिनट की पॉडकास्ट स्क्रिप्ट तैयार करें
- घटक: परिचय, मुख्य भाग, निष्कर्ष

## ३. यूट्यूब स्क्रिप्ट लेखन

- ५ मिनट के वीडियो के लिए स्क्रिप्ट लिखें
- आकर्षक शुरुआत), मुख्य सामग्री), कार्य हेतु प्रेरणा), जैसे लाइक, शेयर, सब्सक्राइब.

### उदाहरण एवं उपयोगिता (Exemplars & Utility):

१. स्पष्ट और संक्षिप्त ऑनलाइन न्यूज़ स्टोरी, उपयुक्त संरचना वाली डिजिटल न्यूज़ तथा ३–५ मिनट के पॉडकास्ट के लिए प्रभावी स्क्रिप्ट तैयार करके वस्तुनिष्ठ और जानकारीपूर्ण डिजिटल मीडिया लेखन किया जा सकता है।

२. छात्रों का डिजिटल मीडिया लेखन कौशल विकसित होता है, ऑनलाइन न्यूज़, पॉडकास्ट और यूट्यूब के लिए व्यावसायिक सामग्री तैयार की जा सकती है तथा जानकारी को सटीक, प्रभावशाली और दर्शक-केंद्रित तरीके से प्रस्तुत करने की क्षमता बढ़ती है।

| Experiment No.6 | तकनीकी लेखन एवं सॉफ्टवेयर दस्तावेज़ीकरण परियोजना | 2 Hrs | CO3 |
|-----------------|--------------------------------------------------|-------|-----|
|-----------------|--------------------------------------------------|-------|-----|

### मकसद (Objectives):

आईटी क्षेत्र के लिए स्पष्ट, सटीक एवं उपयोगकर्ता-केंद्रित तकनीकी लेखन कौशल विकसित करना।

### संबंधित कार्य(Associated Tasks):

#### १. उपयोगकर्ता मार्गदर्शिका

- किसी ऐप/सॉफ्टवेयर (जैसे नोट्स ऐप, ई-लर्निंग प्लेटफॉर्म) की ५००–७०० शब्दों की मार्गदर्शिका तैयार करें
- घटक: परिचय, फीचर्स, उपयोग की प्रक्रिया (क्रमशः), अक्सर पूछे जाने वाले प्रश्न

#### २. क्रिया दस्तावेज़ीकरण

- “अकाउंट कैसे बनाएं” या “फाइल अपलोड प्रक्रिया” का चरणबद्ध वर्णन करें
- क्रमांकित विधि, स्पष्ट निर्देश एवं सरल भाषा का उपयोग करें

#### ३. तकनीकी शब्दावली सूची

- १५–२० आईटी शब्दों की सूची तैयार करें
- अंग्रेज़ी शब्द + हिंदी समतुल्य + संक्षिप्त अर्थ

### उदाहरण एवं उपयोगिता (Exemplars & Utility):

१. ऐप या सॉफ्टवेयर की उपयोगकर्ता मार्गदर्शिका तैयार करके इसमें परिचय, फीचर्स, उपयोग के चरण, प्रश्नसंच तथा “खाता कैसे बनाएं” या “फाइल अपलोड प्रक्रिया” जैसी प्रक्रियाएँ क्रमांकित तरीके से स्पष्ट रूप से प्रस्तुत की जा सकती हैं।



२. विद्यार्थियों का तकनीकी लेखन कौशल विकसित होता है, जानकारी को सटीक और संगत तरीके से प्रस्तुत किया जा सकता है तथा उपयोगकर्ता मार्गदर्शिका और प्रक्रिया दस्तावेज तैयार करने का कौशल प्राप्त होता है।

|                        |                                                          |              |            |
|------------------------|----------------------------------------------------------|--------------|------------|
| <b>Experiment No.7</b> | <b>यूआई / यूएक्स लेखन एवं अनुवाद—स्थानीयकरण परियोजना</b> | <b>2 Hrs</b> | <b>CO3</b> |
|------------------------|----------------------------------------------------------|--------------|------------|

**मकसद (Objectives):**

डिजिटल उत्पादों (ऐप्स/वेबसाइटों) के लिए प्रभावी यूआई टेक्स्ट तथा सटीक अनुवाद एवं स्थानीयकरण कौशल विकसित करना।

**संबंधित कार्य(Associated Tasks):**

१. यूआई टेक्स्ट लेखन

- लॉगिन पेज, साइनअप फॉर्म, सेटिंग्स पेज के लिए टेक्स्ट तैयार करें
- उदाहरण: बटन टेक्स्ट, निर्देश, टूलटिप्स

२. यूएक्स लेखन सुधार

- दिए गए अंग्रेजी यूआई टेक्स्ट को अधिक उपयोगकर्ता-केंद्रित हिंदी में बदलें
- उदाहरण: “Submit” → “जमा करें” / “भेजें” जैसे अधिक स्पष्ट विकल्प

3. अनुवाद कार्य

- १०–१२ वाक्यों के अंग्रेजी आईटी टेक्स्ट का हिंदी में अनुवाद करें
- सटीकता तथा संदर्भ के अनुसार शब्दों का चयन करें

**उदाहरण एवं उपयोगिता (Exemplars & Utility):**

१. लॉगिन पृष्ठ, साइनअप फॉर्म, सेटिंग्स पृष्ठ, बटन पाठ्य, सूचनाएँ और टूलटिप्स के लिए उपयोगकर्ता को समझ में आने वाला स्पष्ट और प्रभावी यूआई/यूएक्स पाठ तैयार करके अंग्रेजी शब्दों के उपयोगकर्ता-केंद्रित हिंदी विकल्प विकसित किए जा सकते हैं।

२. छात्रों का यूआई/यूएक्स लेखन, अंग्रेजी-हिंदी अनुवाद और स्थानीयकरण कौशल विकसित होता है तथा डिजिटल उत्पादों के लिए स्पष्ट, सरल और उपयोगकर्ता-केंद्रित भाषा का उपयोग करके उपयोगकर्ता अनुभव सुधारने में मदद होती है।

|                        |                                               |              |            |
|------------------------|-----------------------------------------------|--------------|------------|
| <b>Experiment No.8</b> | <b>व्यावसायिक लेखन एवं रिपोर्ट तैयार करना</b> | <b>2 Hrs</b> | <b>CO4</b> |
|------------------------|-----------------------------------------------|--------------|------------|

**मकसद (Objectives):**

कार्यालयीन एवं प्रशासनिक कार्यों के लिए औपचारिक, स्पष्ट और प्रभावी लेखन कौशल विकसित करना।

**संबंधित कार्य(Associated Tasks):**

१. ई-मेल लेखन

- 2 औपचारिक ई-मेल लिखें:
  - मीटिंग शेड्यूल करने के लिए



○ प्रोजेक्ट अपडेट देने के लिए

- उचित विषय पंक्ति, अभिवादन, मुख्य भाग और समापन का प्रयोग करें

## २. डिजिटल पत्राचार

- १००—१५० शब्दों में आधिकारिक नोटिस/सूचना तैयार करें
- भाषा स्पष्ट, संक्षिप्त एवं औपचारिक हो

## ३. रिपोर्ट लेखन

- ६००—८०० शब्दों का प्रोजेक्ट/तकनीकी रिपोर्ट तैयार करें
- संरचना: प्रस्तावना, उद्देश्य, पद्धति, निष्कर्ष, सुझाव

### उदाहरण एवं उपयोगिता (Exemplars & Utility):

१. मीटिंग शेड्यूल, प्रोजेक्ट अपडेट, आधिकारिक नोटिस और सूचनाओं के लिए औपचारिक, स्पष्ट और व्यावसायिक ई-मेल के साथ-साथ प्रभावशाली डिजिटल पत्राचार तैयार किया जा सकता है।

२. कार्यालयीन और प्रशासनिक संवाद प्रभावी ढंग से किया जा सकता है, औपचारिक ई-मेल और नोटिस लेखन कौशल विकसित होता है तथा जानकारी को सटीक, संक्षिप्त और उचित ढंग से प्रस्तुत करने की क्षमता बढ़ती है।

|                 |                                   |       |     |
|-----------------|-----------------------------------|-------|-----|
| Experiment No.9 | प्रेजेंटेशन एवं ग्राहक संवाद कौशल | 2 Hrs | CO4 |
|-----------------|-----------------------------------|-------|-----|

**मकसद (Objectives):** व्यावसायिक प्रस्तुतीकरण तथा ग्राहकों के साथ प्रभावी संवाद करने की क्षमता विकसित करना।

### संबंधित कार्य(Associated Tasks):

#### १. प्रेजेंटेशन सामग्री लेखन

- ८—१० स्लाइड्स के लिए सामग्री तैयार करें
- विषय: “नया प्रोजेक्ट प्रस्ताव” / “उत्पाद प्रस्तुतीकरण”
- प्रत्येक स्लाइड के लिए बिंदुवार सामग्री लिखें

#### २. भाषण/प्रेजेंटेशन स्क्रिप्ट

- ३—५ मिनट की प्रस्तुति स्क्रिप्ट तैयार करें
- स्पष्ट संरचना: परिचय, मुख्य बिंदु, निष्कर्ष

#### ३. ग्राहक संवाद

- शिकायत निवारण
- उत्पाद की जानकारी देना
- नम्र, व्यावसायिक एवं संतोषजनक भाषा का प्रयोग करें

#### ४. भूमिका-अभिनय गतिविधि

- एक छात्र ग्राहक की भूमिका निभाए, दूसरा प्रतिनिधि की
- संवाद प्रस्तुत करें और प्रतिक्रिया प्राप्त करें

### उदाहरण एवं उपयोगिता (Exemplars & Utility):



१. “नई परियोजना प्रस्ताव” या “उत्पाद प्रस्तुति” के लिए विषयानुसार स्लाइड सामग्री, ३-५ मिनट की प्रस्तुति स्क्रिप्ट तथा प्रस्तावना, मुख्य बिंदु और निष्कर्ष की उचित संरचना का उपयोग करके प्रभावी प्रस्तुति तैयार की जा सकती है।

२. छात्रों की व्यावसायिक प्रस्तुति और ग्राहक संवाद कौशल विकसित होते हैं, जानकारी को आकर्षक और स्पष्ट रूप से प्रस्तुत किया जा सकता है तथा आत्मविश्वास के साथ भाषण, शिकायत निवारण और उत्पाद जानकारी प्रस्तुत करने की क्षमता बढ़ती है।

| Experiment No.10 | छोटा प्रोजेक्ट (मिनी प्रोजेक्ट) | 6 Hrs | CO4 |
|------------------|---------------------------------|-------|-----|
|------------------|---------------------------------|-------|-----|

निम्नलिखित में से कोई एक लघु प्रोजेक्ट तैयार करें। प्रोजेक्ट तैयार करने के बाद उसे लिंकडइन या अपने स्वयं के ब्लॉग पर साझा करें। लघु प्रोजेक्ट के लिए प्रतीकात्मक उदाहरण निम्नलिखित हैं:

#### १. लघु प्रोजेक्ट (मिनी प्रोजेक्ट): कृत्रिम बुद्धिमत्ता आधारित शिक्षण प्रणाली:

इस प्रोजेक्ट में कृत्रिम बुद्धिमत्ता पर हिंदी में रिपोर्ट तैयार करना, उससे संबंधित प्रस्तुतीकरण बनाना, तथा कृत्रिम बुद्धिमत्ता (ए.आई.) आधारित मोबाइल ऐप की उपयोगकर्ता पुस्तिका तैयार करना अपेक्षित है। इसके साथ भारत में कृत्रिम बुद्धिमत्ता क्षेत्र के स्टार्टअप्स का सर्वेक्षण भी किया जा सकता है।

#### २. लघु प्रोजेक्ट (मिनी प्रोजेक्ट): साइबर सुरक्षा जागरूकता और डिजिटल संरक्षण प्रणाली:

इस प्रोजेक्ट में साइबर सुरक्षा पर विस्तृत रिपोर्ट, साइबर हमलों से बचाव पर प्रस्तुतीकरण, ए.टी.एम. मशीन या मोबाइल बैंकिंग ऐप की कृत्रिम बुद्धिमत्ता (ए.आई.) आधारित उपयोगकर्ता पुस्तिका, तथा साइबर सुरक्षा क्षेत्र की प्रसिद्ध व्यक्तियों और स्टार्टअप्स का सर्वेक्षण शामिल होगा।

#### ३. लघु प्रोजेक्ट (मिनी प्रोजेक्ट): क्लाउड कंप्यूटिंग और आधुनिक शिक्षा प्रबंधन:

इस प्रोजेक्ट में क्लाउड कंप्यूटिंग तकनीक पर रिपोर्ट, उसके लाभ और उपयोगों पर प्रस्तुतीकरण, कॉलेज के लिए उद्योग संसाधन नियोजन प्रणाली (ई.आर.पी. सॉफ्टवेयर) की उपयोगकर्ता पुस्तिका, तथा क्लाउड तकनीक का उपयोग करने वाले भारतीय स्टार्टअप्स का सर्वेक्षण तैयार करना अपेक्षित है।

#### ४. लघु प्रोजेक्ट (मिनी प्रोजेक्ट): उभरती सूचना प्रौद्योगिकी का समाज और उद्योगों पर प्रभाव:

इस प्रोजेक्ट में कृत्रिम बुद्धिमत्ता (ए.आई.), साइबर सुरक्षा और क्लाउड कंप्यूटिंग जैसी उभरती तकनीकों का अध्ययन करके इन तकनीकों का समाज और उद्योगों पर प्रभाव विषय पर हिंदी में रिपोर्ट और प्रस्तुतीकरण तैयार करना शामिल होगा। साथ ही कॉलेज के वार्षिक स्नेह सम्मेलन कार्यक्रम के लिए डिजिटल स्क्रिप्ट तैयार करना, सूत्रसंचालन करना, उससे संबंधित वीडियो रिकॉर्डिंग प्रस्तुतीकरण, तथा १० प्रसिद्ध पूर्व विद्यार्थियों का सर्वेक्षण प्रस्तुत करना अपेक्षित है।

#### Textbooks:



१. पूर्ण हिंदी व्याकरण और रचना – डॉ. अरविंद कुमार, ल्यूसेंट पब्लिकेशन (२०२०)।
२. हिंदी भाषा और संप्रेषण कौशल – डॉ. नरेश मिश्र, नीरज पब्लिकेशन, आयएसबीएन: ९७८९३९१००४३१६।
३. डिजिटल मीडिया लेखन – डॉ. संजय द्विवेदी, इंद्रा पब्लिशिंग हाउस (२०१९), आयएसबीएन: ९७८९३८८३३८७५२।
४. मीडिया लेखन और संपादन – डॉ. ओमप्रकाश सिंह, अमर प्रकाशन (२०१३), आयएसबीएन-१०: ९३८८३३८७५८।
५. तकनीकी हिंदी लेखन – डॉ. रामकुमार वर्मा, साहित्य अकादमी (२०१७), आयएसबीएन: ९७८८१२६०५०७३४।
६. अनुवाद विज्ञान – डॉ. भोलानाथ तिवारी, शब्दकार प्रकाशन, दिल्ली, आयएसबीएन: ८१२६०५०७३।

**Reference Books:**

- १ राजभाषा हिंदी और कार्यालयी प्रयोग – डॉ. कैलाशचंद्र भाटिया, हार्डकर, २०२५,
- २ प्रभावी संचार कौशल – विभिन्न लेखक, नोशन प्रेस, १८ मई २०२०, आयएसबीएन -१०: १६४८९९२५३६, आयएसबीएन - १३: ९७८१६४८९९२५३७
- ३ हिंदी-अंग्रेजी शब्दकोश (ऑक्सफोर्ड) ऑक्सफोर्ड प्रकाशन, २०२० (५वां संस्करण), आयएसबीएन -१३: ९७८०१९५६४८२८८

**Strength of CO-PO-PSO Mapping**

| CO  | PO1  | PO2  | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|------|------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 2    | 2    | 2   | 1   | 1   | 2   | -   | -   | 2   | 2    | -    | 2    | 1    | 1    |
| CO2 | 3    | 3    | 3   | 2   | 3   | 1   | -   | -   | 2   | 3    | -    | 3    | 2    | 2    |
| CO3 | 2    | 2    | 3   | 2   | 2   | 2   | -   | -   | 3   | 3    | -    | 2    | 3    | 2    |
| CO4 | 2    | 2    | 2   | 1   | 2   | 3   | -   | -   | 3   | 3    | -    | 2    | 2    | 3    |
| Avg | 2.25 | 2.25 | 2.5 | 1.5 | 2.0 | 2.0 | -   | -   | 2.5 | 2.75 | -    | 2.25 | 2.0  | 2.0  |

**Assessment Pattern**

| BT Level | CCE based on ARCV |       |       |       |       |       |       |       |       |        |
|----------|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
|          | Exp 1             | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10 |
| CO       | CO1               | CO1   | CO1   | CO2   | CO2   | CO3   | CO3   | CO4   | CO4   | CO4    |
| L1       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |
| L2       | ✓                 | ✓     | ✓     | -     | -     | -     | -     | -     | -     | -      |
| L3       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |
| L4       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |
| L5       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |
| L6       | -                 | -     | -     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓      |



**यह पाठ्यक्रम निम्नलिखित उन्नत पाठ्यक्रमों के लिए आधार के रूप में कार्य करता है:**

- उन्नत तकनीकी लेखन एवं सॉफ्टवेयर दस्तावेजीकरण
- ब्लॉग, सोशल मीडिया तथा डिजिटल ब्रांडिंग
- यूजर इंटरफेस एवं यूजर एक्सपीरियंस के लिए सामग्री लेखन
- विविध सामग्री एवं आईटी स्थानीयकरण.
- व्यावसायिक ई-मेल, रिपोर्ट एवं प्रस्तुतीकरण कौशल
- डिजिटल न्यूज़, स्क्रिप्ट लेखन एवं मल्टीमीडिया कंटेंट

**जॉब मैपिंग: इस कोर्स को सीखने के बाद मिलने वाले जॉब/भविष्य के मौके:**

- कंटेंट राइटिंग और डिजिटल मीडिया।
- आईटी और टेक्निकल राइटिंग।
- ट्रांसलेशन और लोकलाइजेशन।
- कॉर्पोरेट और एडमिनिस्ट्रेटिव रोल्स।
- मीडिया और कम्युनिकेशन।
- फ्रीलांसिंग और एंटरप्रेन्योरशिप।
- मीडिया, कॉर्पोरेट और फ्रीलांसिंग रोजगार



|                 |                              |          |        |                    |              |    |                |  |
|-----------------|------------------------------|----------|--------|--------------------|--------------|----|----------------|--|
| Program:        | S. Y. B. Tech.: IT           |          |        |                    | Semester:    |    | IV             |  |
| Course:         | Startup and Entrepreneurship |          |        |                    | Course Code: |    | R25-IT-EEM-218 |  |
| Teaching Scheme |                              |          |        | Examination Scheme |              |    |                |  |
| Lecture         | Practical                    | Tutorial | Credit | CCE                | ESE          | TW | OR             |  |
| 02              | -                            | -        | 02     | 50                 | -            | -  | -              |  |

**Course Description:**

The course is designed to develop entrepreneurial mindset, creativity, and innovation among students. It introduces the fundamental concepts of entrepreneurship, including idea generation, opportunity recognition, business model development, and start-up planning. The course covers key aspects such as market research, funding strategies, legal and regulatory requirements, intellectual property rights, and scaling of ventures. Students are also exposed to real-world case studies, emerging trends in start-ups, and the role of technology in entrepreneurship. Practical components like business plan preparation and pitching help students gain hands-on experience in launching and managing a start-up.

**Course Relevance:**

The course is highly relevant in today's dynamic and competitive global economy, where innovation and self-employment are key drivers of growth. It equips students with the skills and knowledge required to become job creators rather than job seekers. With the rapid rise of start-up ecosystems and government initiatives promoting entrepreneurship, this course prepares students to identify business opportunities and convert ideas into viable ventures. It also enhances critical thinking, problem-solving, leadership, and risk management abilities. Furthermore, the course is beneficial for students across disciplines, enabling them to apply entrepreneurial principles in technology, management, and social sectors.

**Prerequisite:**

Communication Skills, Problem-Solving and Analytical Thinking, Teamwork and Leadership Qualities, Fundamentals of IT Engineering, Creativity and Innovation Mindset, Computer and Internet Literacy

**Course Objectives:**

1. To encourage students to build new technology, knowledge system based on innovations and can address local challenges.
2. Creating environment to innovate and build products towards sustainable development goals.
3. To provide platform for speedy communication and market reach of technology/ product developed by students.
4. To have start up ecosystem by bridging the gap between academia, industries and financial institutions, government support.

**Course Outcomes:**

After learning the course, students will be able to

| <b>CO</b>  | <b>Course Outcome</b>                                                                                                                                                           | <b>Bloom's Level</b> |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <b>CO1</b> | <b>DISCUSS</b> key concepts and framework of innovation and start-up ecosystem.                                                                                                 | <b>2</b>             |
| <b>CO2</b> | <b>USE</b> knowledge of how to develop start up ecosystem, its key components and how to influence and manage dynamics between them and increase the productivity of ecosystem. | <b>3</b>             |



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                |               |            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|---------------|------------|
| <b>CO3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>DISCUSS</b> the role of different stakeholders in ecosystem in building and supporting growth of start-ups. | <b>2</b>      |            |
| <b>CO4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>DEMONSTRATE</b> small-scale industries, support agencies, project reporting and industrial ownership.       | <b>3</b>      |            |
| <b>Course Contents</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                |               |            |
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Introduction to Entrepreneurship &amp; Start-up Opportunity</b>                                             | <b>7 Hrs.</b> | <b>CO1</b> |
| <p>Entrepreneurship: Definition and evolution, functions, types. Concept and stages of entrepreneurship. Role of entrepreneurship in economic development. Identify business opportunity with problem identification, Artificial Intelligence (AI) for startup idea generation, market size, existing pains for customers, existing alternatives, customer psychology, willingness to pay, customer segments. Startup opportunities in agriculture, manufacturing, packaging, digital services and sustainability.</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b><br/>Exemplars/Case studies/Practical Applications and usage</p> <p>1. Case Study A) Any Globally Successful IT Entrepreneur B) Start-up opportunities using CRED Business Model.</p> <p>3. Idea Generation Challenge: Present Business Ideas such as tech-based, social impact, service-based or product based.</p> |                                                                                                                |               |            |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Product/ Service Proposal and Entrepreneurship management</b>                                               | <b>7 Hrs.</b> | <b>CO2</b> |
| <p>Introduction to 5S methodology, Plan-Do-Study-Act (PDCA) Cycle, Government startup support systems, Value Proposition Canvas, problem-solution fit, brainstorming, competition analysis, creating competitive advantage, sustainable differentiation.</p> <p>Entrepreneurship Management: entrepreneurial qualities, Leadership, Entrepreneurship Building, Analyzing Marketing Opportunities, Market Survey Techniques, Profit and Loss statement, Balance sheet, Design Thinking, Design-Driven Innovation, Systems thinking</p> <p><b>Exemplars/Case studies/Practical Applications and usage:</b><br/>1. Proposal for startup business model considering risky assumptions related to product, market, business and execution capabilities.</p> <p>2. Presentation report e-commerce companies focusing on competition analysis and competitive advantage via its web portal.</p>                      |                                                                                                                |               |            |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Business model</b>                                                                                          | <b>8 Hrs.</b> | <b>CO3</b> |
| <p>Introduction to Business Model Canvas: Definition and purpose of a business model, Types, Lean canvas, Risky assumptions related to product, market, business and execution capabilities, Incubation and acceleration, Human Resource management in startups, Government startup support systems: Startup India, Micro Units Development and Refinance Agency (MSME), Small Industries Development Bank of India (SIDBI), Micro Units Development and Refinance Agency (MUDRA), National Small Industries Corporation (NSIC), District Industries Centre (DIC), Subsidy awareness, legal startup basics,</p>                                                                                                                                                                                                                                                                                               |                                                                                                                |               |            |



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                      |               |            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|---------------|------------|
| <b>Exemplars/Case studies/Practical Applications and usage:</b><br>1. Map the Business Model Canvas for a well-known startup.<br>2. Support agencies for tech startups in India: MSME, SIDBI, MUDRA, NSIC, DIC supporting startups. Summarize their services, eligibility and application process                                                                                                                                                                                                                                                                                                                |                                                      |               |            |
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Small Scale Industries and Marketing strategy</b> | <b>8 Hrs.</b> | <b>CO4</b> |
| <p>Small Scale Industries: Project Preparation, Industrial ownership: partnership definition, characteristics, types, agreement, registration, rights/duties, advantages/disadvantages, sole proprietorship: features, scope, pros/cons.</p> <p>Branding and Positioning: Introduction to Brand-Elements of brand identity: name, logo, voice, tone, and values. Importance of brand and branding strategy, positioning, market penetration strategy/ plan, digital marketing, use of social media, customer acquisition, AI-based digital marketing tools, digital business tools, startup pitching skills.</p> |                                                      |               |            |
| <b>Exemplars/Case studies/Practical Applications and usage:</b><br>1. Study of Ministry of Corporate Affairs (MCA) services related to marketing strategy for digital marketing, use of social media in concern with start-up and entrepreneurship.<br>2. Visit any start-up. Post-visit activity: Prepare, present your own small scale industry setup plan: Outline the steps to register and launch a small-scale IT business in India. Refer state, central government's official portals for preparing proposal.                                                                                            |                                                      |               |            |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                      |               |            |
| 1. Bygrave, W.D., Zacharakis, A., & Corbett, A.C. Entrepreneurship, 6th Edition, 2025, Wiley, ISBN: 9781394262809.<br>2. Drucker, Peter F. Innovation and Entrepreneurship: Practice and Principles, Reprint Edition, 2006, Harper Business, ISBN: 9780060851132.<br>3. Osterwalder, Alexander & Pigneur, Yves. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, 1st Edition, 2010. Wiley, ISBN: 9780470876411.                                                                                                                                                            |                                                      |               |            |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                      |               |            |
| 1. Ries, Eric. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, 1st Edition, 2011, Crown Business, ISBN: 9780307887894.<br>2. Kawasaki, Guy. The Art of the Start 2.0: The Time-Tested, Battle-Hardened Guide for Anyone Starting Anything,, 2015, Penguin Random House ISBN: 9781591847847.                                                                                                                                                                                                                                                     |                                                      |               |            |
| <b>Website Links/ Online Resources</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                      |               |            |
| 1. <b>Entrepreneurship Essentials: Prof. Manoj Kumar Mondal, IIT Kharagpur</b><br><a href="https://onlinecourses.nptel.ac.in/noc20_ge08/preview">https://onlinecourses.nptel.ac.in/noc20_ge08/preview</a><br>2. <b>Entrepreneurship: Prof. C Bhaktavatsala Rao, IIT Madras</b><br><a href="https://onlinecourses.nptel.ac.in/noc21_mg70/preview">https://onlinecourses.nptel.ac.in/noc21_mg70/preview</a>                                                                                                                                                                                                        |                                                      |               |            |



3. **Entrepreneurship Management: Sujit Mukherjee, MAKA University of Technology,**  
[https://onlinecourses.swayam2.ac.in/cec24\\_mg28/preview](https://onlinecourses.swayam2.ac.in/cec24_mg28/preview)

4. **Principles of Management: Prof. Usha Lenka, IIT Roorkee**  
<https://nptel.ac.in/courses/110107150>

5. **Startup India: Government Startup Schemes**  
<https://saccindia.org/india/>

6. **Success stories of IT Entrepreneurs:**

- The Story of Facebook: Mark Zuckerberg, <https://youtu.be/f6Pq68S8-rQ>
- OpenAI's Sam Altman, [https://youtu.be/5MWT\\_doo68k](https://youtu.be/5MWT_doo68k)
- Paytm: Vijay Sharma, <https://www.youtube.com/watch?v=Dw3UVWpCMmE>
- Flipkart: Sachin & Binny Bansal, <https://www.youtube.com/watch?v=ye2LLhZdHLM>
- Ola: Bhavish Aggarwal, [https://youtu.be/AtAWMICw\\_us?t=277](https://youtu.be/AtAWMICw_us?t=277)

### Strength of CO-PO-PSO Mapping

| CO  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1   | 2   | 1    | 1    | 2    | 2    | 3    |
| CO2 | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1   | 2   | 1    | 1    | 2    | 2    | 3    |
| CO3 | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1   | 2   | 1    | 1    | 2    | 2    | 3    |
| CO4 | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1   | 2   | 1    | 1    | 2    | 2    | 3    |
| Avg | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1   | 2   | 1    | 1    | 2    | 2    | 3    |

### Assessment Pattern

| BT<br>Level | CCE |     |     |     | ESE |     |     |     |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|
|             | CO1 | CO2 | CO3 | CO4 | CO1 | CO2 | CO3 | CO4 |
|             | 10  | 10  | 10  | 10  | 15  | 15  | 15  | 15  |
| L1          | –   | –   | –   | –   | –   | –   | –   | –   |
| L2          | √   | –   | √   | –   | √   | –   | √   | –   |
| L3          | –   | √   | –   | √   | –   | √   | –   | √   |
| L4          | –   | –   | –   | –   | –   | –   | –   | –   |
| L5          | –   | –   | –   | –   | –   | –   | –   | –   |
| L6          | –   | –   | –   | –   | –   | –   | –   | –   |

**This course serves as a prerequisite for maps with the following future courses:**

- Innovation and related startups
- Research and Higher Studies
- Business Management Studies



**Job Mapping:**

**Job/Future opportunities that one can get after learning this course:**

- Startup Founder
- Entrepreneur
- Business Analyst
- Product Manager
- Startup India initiatives
- Incubation Centre Associate



|                 |                                       |          |        |                    |                |    |    |
|-----------------|---------------------------------------|----------|--------|--------------------|----------------|----|----|
| Program:        | S. Y. B. Tech                         |          |        | Semester:          | IV             |    |    |
| Course:         | Database Management System Laboratory |          |        | Course Code:       | R25-IT-PCC-219 |    |    |
| Teaching Scheme |                                       |          |        | Examination Scheme |                |    |    |
| Lecture         | Practical                             | Tutorial | Credit | CCE                | ESE            | PR | OR |
| --              | 02                                    | --       | 01     | --                 | --             | 25 | -- |

**Course Description:**

The Database Management System (DBMS) Lab provides hands-on experience in designing, implementing, and managing relational databases using Structured Query Language (SQL) and procedural extensions such as PL/SQL. The course focuses on practical implementation of database concepts including data definition, data manipulation, constraints, joins, views, indexes, and transaction management. Students design relational schemas, write complex queries for data retrieval and modification, and develop stored procedures, triggers, and functions to automate database operations. The lab also introduces concepts of normalization, integrity constraints, and basic database administration practices. Through practical exercises and mini-projects, students learn to apply database technologies to develop efficient and reliable data-driven applications.

**Course Relevance:**

The Database Management System Lab is essential for developing practical skills in designing and managing databases used in real-world applications. It enables students to apply theoretical concepts of DBMS by writing SQL and PL/SQL queries, creating relational schemas, and implementing constraints, procedures, and triggers. The course strengthens problem-solving abilities related to data storage, retrieval, and management in software systems. It also prepares students to work with modern data-driven applications used in industries such as banking, e-commerce, healthcare, and enterprise systems, thereby supporting core competencies required in the Information Technology domain.

**Prerequisite:**

Basic programming knowledge (C/C++ or Python) and fundamental problem-solving skills.

**Bridge Content:**

It revisits fundamental concepts such as basics of database systems, introduction to relational models, primary and foreign keys, data types, and basic commands of Structured Query Language, Data Structures, Programming Fundamentals.

**Course Objectives:**

To UNDERSTAND students to the fundamental concepts of database systems.

To APPLY knowledge of the relational data model and operations for designing well-structured relational databases.

To ANALYZE students' ability to use SQL and PL/SQL for defining, manipulating, and managing relational databases, and to implement advanced database features such as procedures, functions, and triggers.

To EXPLAIN of transaction management, concurrency control mechanisms, and recovery techniques to ensure reliable and consistent database operations.

To ANALYZE modern data management technologies beyond traditional relational databases by understanding the concepts of NoSQL databases, Big Data frameworks, cloud-based database services, and AI/ML integration with databases.



|  |
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|  |
|--|

**Course Outcomes:**

After learning the course, students will be able to

| CO  | Course Outcome                                                                                                                                                                     | Bloom's Level |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| CO1 | <b>DEMONSTRATE</b> ER/EER diagrams and convert them into relational database tables for representing real-world data requirements.                                                 | 3             |
| CO2 | <b>DEMONSTRATE</b> complex database queries using SQL and develop PL/SQL programs including procedures, functions, cursors, and triggers for database applications.                | 3             |
| CO3 | <b>ANALYZE</b> relational database schemas and apply normalization techniques to eliminate redundancy and anomalies in database design.                                            | 4             |
| CO4 | <b>ANALYZE</b> database transactions and apply appropriate concurrency control and recovery techniques to maintain data consistency and reliability.                               | 4             |
| CO5 | <b>IMPLEMENT</b> modern database technologies including NoSQL, Big Data frameworks, cloud databases, and AI-enabled database applications for real-world data management problems. | 3             |

**List of Practical**

| Experiment No.1 | ER Diagram | 2 Hrs | CO1 |
|-----------------|------------|-------|-----|
|-----------------|------------|-------|-----|

**Objective:**

To understand the components and conventions of Entity–Relationship Model and practice converting ER/EER diagrams into relational tables in a Relational Database Management System.

**Associated Task:**

Design an ER diagram for a College Database System that includes entities such as Student, Course, Faculty, Department, and Enrollment. Identify attributes, primary keys, and relationships among entities. Convert the ER diagram into corresponding relational tables.

Design and implement a college database system to manage student admissions, course registration, faculty allocation, departmental records, and student enrollments using ER modeling and relational schema design.

**Exemplars and Utility:**

This experiment helps students understand real-world database design by developing the ability to model entities, define relationships, identify keys, and convert ER diagrams into normalized relational tables for efficient data management.

| Experiment No.2 | SQL Queries | 2 Hrs | CO2 |
|-----------------|-------------|-------|-----|
|-----------------|-------------|-------|-----|

**Objective:**

To practice database creation and perform various data retrieval and manipulation operations using Structured Query Language in a Relational Database Management System.

**Problem Statement:** Design a Hospital Management Database containing tables such as Patient,



Doctor, Appointment, and Department.

1. Create tables using DDL commands with appropriate constraints.
2. Insert and modify records using DML commands.
3. Write SQL queries using WHERE, ORDER BY, GROUP BY, Pattern Matching using LIKE, IN, BETWEEN conditions.
4. Use JOIN operations to retrieve details of patients and their assigned doctors.
5. Apply Set Operations and Aggregate Functions for reports such as number of patients handled by each doctor.

### Exemplars and Utility:

The Hospital Management Database System using SQL is to be implemented to manage patient records, doctor details, appointments, departmental information, and generate reports through queries, joins, set operations, and aggregate functions. It helps students to gain practical knowledge of SQL and relational database operations by creating tables, manipulating data, and retrieving meaningful healthcare information using various query techniques.

|                        |                                        |              |            |
|------------------------|----------------------------------------|--------------|------------|
| <b>Experiment No.3</b> | <b>Relational Model: Normalization</b> | <b>2 Hrs</b> | <b>CO3</b> |
|------------------------|----------------------------------------|--------------|------------|

### Objective:

To understand relational model concepts such as attributes, tuples, relations, keys, integrity constraints, and apply normalization techniques in a Relational Database Management System

### Problem Statement:

A Library Management System stores data in a single unnormalized table containing attributes such as Book\_ID, Book\_Title, Author\_Name, Publisher, Student\_ID, Student\_Name, Issue\_Date, and Return\_Date.

1. Identify functional dependencies in the given relation.
2. Normalize the relation step-by-step into 1NF, 2NF, 3NF, and BCNF.
3. Create the final normalized relational tables and specify the primary and foreign keys.

### Exemplars and Utility:

The Library Management Database System will analyze functional dependencies and will transform an unnormalized relation into 1NF, 2NF, 3NF, and BCNF to organize book issue and student records efficiently. It will demonstrate importance of database normalization in reducing redundancy, eliminating anomalies and designing efficient, consistent, and reliable relational database schemas.

|                        |                               |              |            |
|------------------------|-------------------------------|--------------|------------|
| <b>Experiment No.4</b> | <b>PL/SQL: View and Index</b> | <b>2 Hrs</b> | <b>CO3</b> |
|------------------------|-------------------------------|--------------|------------|

### Objective:

To implement advanced database features and automate database operations using PL/SQL.

### Problem Statement:

Develop an Online Shopping Database System containing tables such as *Customer*, *Product*, *Order*, and *Payment*.

1. Create views to display customer order summaries.
2. Create indexes on frequently searched attributes such as Product\_ID.



### 3. Write PL/SQL programs using control structures to calculate the total order amount.

#### Exemplars and Utility:

The Online Shopping Database System will manage customer details, products, orders, and payments while implementing views, indexes, and procedural programs for efficient order processing and reporting. It will help students to understand advanced database concepts such as views, indexing and PL/SQL programming to improve query performance, automate calculations and manage real-world e-commerce applications effectively.

|                        |                                  |              |            |
|------------------------|----------------------------------|--------------|------------|
| <b>Experiment No.5</b> | <b>PL/SQL: Stored Procedures</b> | <b>2 Hrs</b> | <b>CO3</b> |
|------------------------|----------------------------------|--------------|------------|

#### Objective:

To implement and execute PL/SQL stored procedures and functions to perform database operations such as data insertion, update and calculation efficiently.

**Problem Statement:** Write and execute a PL/SQL stored procedure and a function to perform suitable operations on a database table. The procedure should update or modify data in the table, and the function should return a calculated value (such as total balance, salary, or count of records) based on the table data.

#### Exemplars and Utility:

It will demonstrate PL/SQL stored procedure to update or modify data in a database table and a PL/SQL function to calculate and return summary values such as total salary, balance, or record count based on table data. It will help students understand how to implement PL/SQL procedural for data manipulation, business logic implementation.

|                        |                         |              |            |
|------------------------|-------------------------|--------------|------------|
| <b>Experiment No.6</b> | <b>PL/SQL: Triggers</b> | <b>2 Hrs</b> | <b>CO3</b> |
|------------------------|-------------------------|--------------|------------|

**Objective:** To create and execute PL/SQL triggers to automatically perform specific actions on a database table when INSERT, UPDATE, or DELETE operations occur.

**Problem Statement:** Write and implement a PL/SQL trigger on a database table that automatically performs a suitable task when data is modified. For example, create a trigger that records changes in an audit table whenever a record is inserted, updated, or deleted in the main table.

#### Exemplars and Utility

The PL/SQL trigger automatically perform tasks such as maintaining audit logs whenever records are inserted, updated or deleted in the main table. It will demonstrate concept of database triggers and event-driven programming to automate database operations in real-world applications.

|                        |                       |              |            |
|------------------------|-----------------------|--------------|------------|
| <b>Experiment No.7</b> | <b>PL/SQL: Cursor</b> | <b>4 Hrs</b> | <b>CO3</b> |
|------------------------|-----------------------|--------------|------------|

#### Objective:

To Design and implement a database solution using MySQL to demonstrate the use of cursors.

#### Problem Statement:

Create a table named employee with the following attributes: id (Primary Key), name, salary. Insert



multiple records into the table.

Write a stored procedure named display\_names that:

1. Declares a cursor to fetch employee names from the employee table.
2. Uses a loop to iterate through all records one by one.
3. Displays each employee name using a SELECT statement.
4. Handles the end of the cursor using a CONTINUE HANDLER.
5. Execute the procedure to display all employee names.
6. Additionally, write a query to display names of employees whose salary is greater than 35000.

### Exemplars and Utility:

It effectively demonstrate MySQL/PLSQL stored procedure using a cursor and loop to sequentially fetch and display employee names along with queries to retrieve employees based on salary conditions. It uses cursors, loops, handlers and conditional SQL queries for efficient execution of database operations in relational database systems.

|                        |                            |              |            |
|------------------------|----------------------------|--------------|------------|
| <b>Experiment No.8</b> | <b>Concurrency Control</b> | <b>2 Hrs</b> | <b>CO4</b> |
|------------------------|----------------------------|--------------|------------|

**Objective:** To understand and implement core concepts of database transaction management, including ACID properties, scheduling, concurrency control, and recovery techniques to ensure data consistency and reliability in real-world systems.

**Problem Statement:** To design a secure transaction management system for an online banking application that ensures ACID properties and handles concurrent transactions without data inconsistency or loss.

### Exemplars and Utility:

The secure online banking transaction system will be implemented supporting ACID properties, concurrency control and recovery mechanisms. It will help students understand transaction management, data consistency, concurrency handling, and database reliability in real-world applications.

|                        |                                |              |            |
|------------------------|--------------------------------|--------------|------------|
| <b>Experiment No.9</b> | <b>MongoDB: NOSQL database</b> | <b>2 Hrs</b> | <b>CO5</b> |
|------------------------|--------------------------------|--------------|------------|

### Objective:

To install and use MongoDB for understanding flexible schema design and document-oriented data management.

### Problem Statement:

To perform insertion, update, deletion, and retrieval of documents in MongoDB for a small dataset.

### Exemplars and Utility:

The MongoDB CRUD operations will be implemented by inserting, updating, deleting and retrieving documents from a small dataset. It will help students understand flexible schema design and document-oriented data management using MongoDB and NoSQL database concepts.

|                         |                     |              |                     |
|-------------------------|---------------------|--------------|---------------------|
| <b>Experiment No.10</b> | <b>Mini Project</b> | <b>4 Hrs</b> | <b>CO:1,2,3,4,5</b> |
|-------------------------|---------------------|--------------|---------------------|

**Following are example statements based on real-world applications but not limited to:**

**Mini Project 1:**

**Problem Statement:** Develop a Hospital Management System that manages patient records, doctor appointments, billing and medical reports while demonstrating ER modeling, normalization, SQL operations, transaction management and concurrency control.

**Mini Project 2:**

**Problem Statement:** Design and implement an Online Library Management System to handle book inventory, member registration, book issue/return, fines and secure multi-user database transactions using core DBMS concepts.

**Mini Project 3:**

**Problem Statement:** Create a Railway Reservation System that supports ticket booking, cancellation, seat allocation and concurrent user access while ensuring data consistency, recovery and transaction reliability.

**Mini Project 4:**

**Problem Statement:** Build a College Student Information System that stores student, faculty, course, attendance, examination, and fee details using normalized relational schemas, CRUD operations and transaction processing techniques.

**Textbooks:**

1. Silberschatz A., Korth H. F., Sudarshan S., *Database System Concepts*, 7th Edition, 2019, McGraw-Hill Education, ISBN 978-1260084504

**Reference Books:**

1.Elmasri R., Navathe S., *Fundamentals of Database Systems*, 7th Edition, 2021, Pearson Education, ISBN:978-0137502523.

2.Gupta G. K., *Database Management Systems*, Latest Edition, 1st Edition Reprint, 2011, Tata McGraw-Hill Education, ISBN 978-0070702080.

3.Date C. J., *An Introduction to Database Systems*, 8th Edition, 2004, Pearson Education, ISBN 978-0321197849.

4.Ramakrishnan R., Gehrke J., *Database Management Systems*, 3rd Edition, 2003, McGraw-Hill. ISBN 978-0072465631.

5.Feuerstein S., *Oracle PL/SQL Programming*, 6th Edition, 2014, O'Reilly Media, ISBN 978-1449324452.

6.Bayross, Ivan, *SQL, PL/SQL: The Programming Language of Oracle*. Latest ed, 2010, BPB Publications. ISBN 978-8176569262

7.Sadalage P. J., Fowler M., *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*, 1st Edition, 2012, Addison-Wesley, ISBN 978-0321826626.

8.Mahmood Z. (Ed.), *Cloud Computing: Concepts, Technology and Architecture*, 1st Edition,



2011, Springer, ISBN 978-1441965240.

### Website Links/ Online Resources

**1. MongoDB Inc., MongoDB Manual (Official Documentation):**

<https://www.mongodb.com/docs/>

**2. Data Base Management System: Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay, IIT Kharagpur**

[https://onlinecourses.nptel.ac.in/noc26\\_cs39/preview](https://onlinecourses.nptel.ac.in/noc26_cs39/preview)

**2. Fundamentals of Database Systems: Prof. Arnab Bhattacharya, IIT Kanpur**

<https://nptel.ac.in/courses/106104135>

**3. Structure Query Language: SQL**

<https://www.youtube.com/watch?v=5OdVJbNCSso>

**4. Master Oracle PLSQL:**

<https://www.youtube.com/watch?v=9ic3KEH4Ah4>

**5. Miniproject: MITS Code Coalescence Hackathon 2025**

<https://web.mitsgwalior.in/images/2025/feb/Problem%20Statements-CC-2025.pdf>

**6. Miniproject: Pristine Agency-Hackathon Problem Statement Examples**

<https://pristineagency.eu/blog/hackathon-problem-statements>

### Strength of CO-PO-PSO Mapping

| CO  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   | 2   | 1   | 1   | 1   | 1   | 1   | 1   | 2   | 1    | 3    | 3    | 3    | 2    |
| CO2 | 3   | 3   | 3   | 1   | 2   | 1   | 1   | 2   | 2   | 1    | 3    | 3    | 3    | 2    |
| CO3 | 2   | 3   | 3   | 1   | 3   | 1   | 1   | 2   | 2   | 1    | 3    | 3    | 3    | 2    |
| CO4 | 2   | 3   | 2   | 2   | 1   | 2   | 1   | 2   | 3   | 1    | 3    | 3    | 3    | 2    |
| CO5 | 2   | 2   | 1   | 1   | 2   | 2   | 1   | 2   | 3   | 1    | 3    | 2    | 3    | 1    |
| Avg | 2.4 | 2.6 | 2   | 1.2 | 1.8 | 1.4 | 1   | 1.8 | 2.4 | 1    | 3    | 2.8  | 3    | 1.8  |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE based on ARCV |       |       |       |       |       |       |       |       |        |
|----------|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
|          | Exp 1             | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10 |
| CO       | CO1               | CO2   | CO3   | CO3   | CO3   | CO3   | CO3   | CO4   | CO5   | CO5    |
| L1       | -                 | -     | -     | -     | -     | -     | -     | -     | -     | -      |



|    |   |   |   |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|---|---|---|
| L2 | - | - | - | - | - | - | - | - | - | - |
| L3 | ✓ | ✓ | - | - | - | - | - | - | ✓ | ✓ |
| L4 | - | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✓ |
| L5 | - | - | - | - | - | - | - | - | - | - |
| L6 | - | - | - | - | - | - | - | - | - | ✓ |

**This course serves as a prerequisite for maps with the following future courses:**

- Data Mining and Data Warehousing
- Big Data Analytics
- Cloud Computing
- Artificial Intelligence and Machine Learning
- Web Technologies / Web Application Development:
- Information Retrieval Systems
- Software Engineering / Enterprise Application Development

**Job Mapping:**

**Job/Future opportunities that one can get after learning this course:**

- Database Administrator (DBA)
- Data Analyst
- Software Developer
- Data Engineer
- Business Intelligence (BI) Developer
- Cloud Database Engineer
- Database Developer
- Data Scientist
- System Analyst



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                   |                                               |               |                           |            |                       |                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---------------|---------------------------|------------|-----------------------|----------------------|
| <b>Program:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                   | <b>S. Y. B. Tech</b>                          |               | <b>Semester:</b>          |            | <b>IV</b>             |                      |
| <b>Course:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                   | <b>Object Oriented Programming Laboratory</b> |               | <b>Course Code:</b>       |            | <b>R25-IT-PCC-220</b> |                      |
| <b>Teaching Scheme</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                   |                                               |               | <b>Examination Scheme</b> |            |                       |                      |
| <b>Lecture</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Practical</b>                                                                                                                  | <b>Tutorial</b>                               | <b>Credit</b> | <b>CCE</b>                | <b>ESE</b> | <b>TW</b>             | <b>PR</b>            |
| --                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 02                                                                                                                                | --                                            | 01            | --                        | --         | --                    | 25                   |
| <b>Course Description</b><br>The Object-Oriented Programming lab introduces students to fundamental principles of object-oriented design and programming using Java. The course covers concepts such as classes, objects, inheritance, polymorphism, encapsulation, abstraction, constructors, methods, packages, exception handling, and multithreading. It emphasizes designing reusable and maintainable software systems using OOP principles and implementing them through Java programming.                                                                                                                                                      |                                                                                                                                   |                                               |               |                           |            |                       |                      |
| <b>Course Relevance:</b><br>Object Oriented Programming forms the foundation for modern software development. Most modern programming languages such as Java, Python, C#, and C++ are based on object-oriented concepts. The course helps students understand software design principles, code modularity, and reusable components which are widely used in enterprise applications, web development, mobile applications, and system software.                                                                                                                                                                                                        |                                                                                                                                   |                                               |               |                           |            |                       |                      |
| <b>Prerequisite:</b><br>Programming Fundamentals (C, C++) languages.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                   |                                               |               |                           |            |                       |                      |
| <b>Bridge Content</b><br>Basic understanding of <b>procedural programming</b> using java Programming Language.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                   |                                               |               |                           |            |                       |                      |
| <b>Course Objectives:</b><br>1. Understand the fundamental principles of Object-Oriented Programming and Java programming concepts.<br>2. Apply classes, objects, methods, constructors, arrays, and packages in Java-based applications.<br>3. Implement inheritance, polymorphism, abstraction, interfaces, and encapsulation for developing reusable software systems.<br>4. Develop Java applications using exception handling, multithreading, generics, collections, and file handling techniques.<br>5. Analyze modern software development practices and recent trends in the IT industry using Java and Object-Oriented Programming concepts. |                                                                                                                                   |                                               |               |                           |            |                       |                      |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                   |                                               |               |                           |            |                       |                      |
| <b>CO</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Course Outcome</b>                                                                                                             |                                               |               |                           |            |                       | <b>Bloom's Level</b> |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>DESCRIBE</b> the basic concepts of Object-Oriented Programming and Java programming fundamentals.                              |                                               |               |                           |            |                       | 2                    |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>APPLY</b> classes, objects, methods, constructors, arrays, and packages in Java programs.                                      |                                               |               |                           |            |                       | 3                    |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>IMPLEMENT</b> inheritance, polymorphism, abstraction, interfaces, and encapsulation in Java applications.                      |                                               |               |                           |            |                       | 3                    |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>DEMONSTRATE</b> Java applications using exception handling, multithreading, generics, collections, and file handling concepts. |                                               |               |                           |            |                       | 3                    |



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                       |              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------|
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>ANALYZE</b> modern software development practices and recent trends in the IT industry using Object-Oriented Programming concepts. | <b>4</b>     |
| <b>List of Practical:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                       |              |
| <b>Experiment No.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>JDK Configuration</b>                                                                                                              | <b>2 hrs</b> |
| <p><b>CO1</b></p> <p><b>Objective:</b> To enable students to install and configure the Java Development Kit (JDK) and a Java Integrated Development Environment (IDE) to develop, compile, and run Java programs successfully.</p> <p><b>Associated Tasks:</b></p> <ol style="list-style-type: none"> <li>1. Download and install the JDK.</li> <li>2. Configure JAVA_HOME and PATH environment variables.</li> <li>3. Install Eclipse or IntelliJ IDEA IDE.</li> <li>4. Configure the IDE with the installed JDK.</li> <li>5. Create and run a Hello World Java program.</li> </ol> <p><b>Exemplars and Utility:</b></p> <ol style="list-style-type: none"> <li>1. Install the Java Development Kit.</li> <li>2. Set up Java environment variables.</li> <li>3. Install and configure a Java IDE.</li> <li>4. Create and execute a basic Java program.</li> </ol>                                                                                                                                                      |                                                                                                                                       |              |
| <b>Experiment No.2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Employee Management System using Classes, Objects &amp; Constructors</b>                                                           | <b>2 hrs</b> |
| <p><b>CO1,2</b></p> <p><b>Objective:</b> To enable students to understand and implement the concept of classes, objects, and constructors in Java for initializing employee details and performing operations such as displaying information and calculating annual salary.</p> <p><b>Associated Tasks:</b></p> <ol style="list-style-type: none"> <li>1. Create a Java class to represent employee details.</li> <li>2. Define constructors for object initialization.</li> <li>3. Accept employee information from the user.</li> <li>4. Display employee details and calculate annual salary.</li> </ol> <p><b>Exemplars and Utility:</b></p> <ol style="list-style-type: none"> <li>1. Create an employee class with data members such as employee ID, name, department, and salary.</li> <li>2. Implement default and parameterized constructors along with methods to display details and compute annual salary.</li> <li>3. Execute the program and verify the output for different employee records.</li> </ol> |                                                                                                                                       |              |
| <b>Experiment No.3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Weather Temperature Analysis using Arrays</b>                                                                                      | <b>2 hrs</b> |
| <p><b>CO2,3</b></p> <p><b>Objective:</b> To implement two-dimensional arrays in Java for storing temperature records and performing operations such as insertion, deletion, searching, sorting, and updating.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                       |              |

**Associated Tasks:**

1. Create a 2D array for temperature records.
2. Accept temperature values from the user.
3. Perform insertion and deletion operations.
4. Search and sort temperature values.
5. Update and display temperature records.

**Exemplars and Utility:**

1. Store temperature data using a 2D array.
2. Implement basic array operations.
3. Display updated records after each operation.
4. Verify program output with different inputs.

|                        |                                                                   |              |            |
|------------------------|-------------------------------------------------------------------|--------------|------------|
| <b>Experiment No.4</b> | <b>Online Payment System using Polymorphism &amp; Inheritance</b> | <b>2 hrs</b> | <b>CO3</b> |
|------------------------|-------------------------------------------------------------------|--------------|------------|

**Objective:** To understand inheritance and runtime polymorphism in Java using different payment methods.

**Associated Tasks:**

1. Create a base class Payment with variable amount.
2. Define method makePayment() in the base class.
3. Create subclasses CreditCardPayment, DebitCardPayment, and UPIPayment.
4. Override makePayment() in all subclasses.
5. Demonstrate runtime polymorphism using base class references.

**Exemplars and Utility:**

1. Implement common attributes and methods in the Payment class.
2. Use inheritance for different payment types.
3. Apply method overriding for payment processing.
4. Execute the program and verify outputs for different payment methods.

|                        |                                                                                              |              |            |
|------------------------|----------------------------------------------------------------------------------------------|--------------|------------|
| <b>Experiment No.5</b> | <b>Product Discount Management System using inheritance, polymorphism &amp; abstractions</b> | <b>4 hrs</b> | <b>CO3</b> |
|------------------------|----------------------------------------------------------------------------------------------|--------------|------------|

**Objective:** To implement abstraction, inheritance, and runtime polymorphism using a Product class with discount calculation operations.

**Associated Tasks:**

1. Create an abstract class Product with attributes such as name and price.
2. Define an abstract method calculateDiscount().
3. Create subclasses Electronics, Clothing, and Grocery.
4. Override the calculateDiscount() method in each subclass.
5. Calculate and display the final product price after discount.
6. Demonstrate dynamic binding using base class references.

**Exemplars and Utility:**

1. Implement abstraction using the Product class.
2. Use inheritance for different product categories.
3. Override discount calculation methods in subclasses.
4. Demonstrate runtime polymorphism.
5. Calculate and display discounted prices successfully.

**Experiment No.6****Examination Evaluation System using Interface****2 hrs****CO3**

**Objective:** To implement an interface Exam for different exam types such as OnlineExam, PracticalExam, and TheoryExam with common operations like conducting exams and calculating results.

**Associated Tasks:**

1. Create an interface Exam with methods conductExam() and calculateResult().
2. Implement the interface in OnlineExam, PracticalExam, and TheoryExam classes.
3. Override the interface methods in each class.
4. Create objects and demonstrate the implemented methods.
5. Display results for different exam types.

**Exemplars and Utility:**

1. Define and implement the Exam interface.
2. Demonstrate method overriding in different exam classes.
3. Create objects and invoke methods.
4. Demonstrate interfaces and abstraction in Java.

**Experiment No.7****Exception Handling in Java****2 hrs****CO4**

**Objective:** To implement exception handling in Java for handling runtime errors such as ArithmeticException, NumberFormatException, and ArrayIndexOutOfBoundsException, and upload the program on GitHub.

**Associated Tasks:**

1. Accept two numbers from the user.
2. Perform division operation and display the result.
3. Implement exception handling using try-catch.
4. Handle invalid input, division by zero, and missing arguments.
5. Display appropriate error messages.
6. Upload the program to GitHub with proper commits

**Exemplars and Utility:**

1. Demonstrate handling of runtime errors in Java.
2. Use try, catch, and finally blocks.
3. Improve program reliability and input validation.
4. Use GitHub for version control and code sharing.



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              |              |                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|--------------|---------------------|
| <b>Experiment No.8</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Movie Ticket Booking System Using Generic Programming</b> | <b>2 hrs</b> | <b>CO4</b>          |
| <p><b>Objective:</b> To use Java Generics and Collections to manage movie ticket booking operations like add, delete, and display tickets.</p> <p><b>Associated Tasks:</b></p> <ol style="list-style-type: none"> <li>1. Create a generic Ticket class.</li> <li>2. Use ArrayList with Generics.</li> <li>3. Implement booking and cancellation.</li> <li>4. Display all tickets.</li> </ol> <p><b>Exemplars and Utility:</b></p> <ol style="list-style-type: none"> <li>1. Demonstrates Generics with Collections.</li> <li>2. Performs basic CRUD operations.</li> <li>3. Uses ArrayList for dynamic storage.</li> </ol>                                                                                                            |                                                              |              |                     |
| <b>Experiment No.09</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Digital Diary system using File Handling</b>              | <b>2 hrs</b> | <b>CO4,5</b>        |
| <p><b>Objective:</b> To help students understand file handling concepts in Java and implement a simple file-based diary system in Java for storing, retrieving, updating, deleting, and searching personal notes.</p> <p><b>Associated Tasks:</b></p> <ol style="list-style-type: none"> <li>1. Add notes to a file.</li> <li>2. Display all notes.</li> <li>3. Update existing notes.</li> <li>4. Delete notes.</li> <li>5. Search notes using keywords.</li> </ol> <p><b>Exemplars and Utility:</b></p> <ol style="list-style-type: none"> <li>1. Demonstrates Java file handling.</li> <li>2. Implements CRUD operations.</li> <li>3. Manages data using files.</li> <li>4. Useful for real-world note storage systems.</li> </ol> |                                                              |              |                     |
| <b>Experiment No.10</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Mini Projects</b>                                         | <b>4 hrs</b> | <b>CO:1,2,3,4,5</b> |
| <p>Following are example statements based on real-world applications but not limited to:</p> <p><b>Mini Project 1: Transport Management System</b><br/> <b>Problem Statement:</b> Design and develop a Transport Management System using Java that manages vehicle information, passenger booking, route scheduling, ticket reservation and payment processing. The system should demonstrate the implementation of Object-Oriented Programming concepts such as classes, objects, inheritance, polymorphism, abstraction, interfaces, exception handling, collections and file handling for efficient transport operations.</p> <p><b>Mini Project 2: Online Shopping Management System</b></p>                                      |                                                              |              |                     |



**Problem Statement:** Design and develop an Online Shopping Management System using Java that supports product management, customer registration, shopping cart operations, order placement, payment processing, and invoice generation. The system should demonstrate secure transaction handling and implementation of Object-Oriented Programming concepts along with collections and file handling.

### Mini Project 3: Vehicle Rental Management System

**Problem Statement:** Design and develop a Vehicle Rental Management System using Java that manages vehicle records, customer registration, rental booking, return processing, payment handling, and rental history. The system should demonstrate the implementation of Object-Oriented Programming concepts, exception handling, collections, interfaces and file handling for efficient vehicle rental operations.

### Mini Project 4: Restaurant Management System

**Problem Statement:** Design and develop a Restaurant Management System using Java that manages menu items, table reservations, customer orders, billing, and payment processing. The system should demonstrate the use of Object-Oriented Programming concepts, collections, exception handling, interfaces and file handling for efficient restaurant operations.

### Textbooks:

1. Herbert Schildt & Danny Coward – Java: The Complete Reference, 13th Edition, 2024, McGraw Hill, ISBN-13: 978-1265058432.
2. Kathy Sierra, Bert Bates & Trisha Gee -Head First Java, 3rd Edition, 2022, O'Reilly Media, ISBN-13: 978-1491910771.
3. E. Balagurusamy -Object Oriented Programming with Java, 7th Edition, 2020, McGraw Hill, ISBN-13: 978-9353162344.

### Reference Books:

1. Cay S. Horstmann – Core Java Volume I: Fundamentals, 12th Edition, 2021, Pearson, ISBN:978-0137673629.
2. Bruce Eckel, Thinking in Java, 4th Edition, 2006, Prentice Hall, ISBN: 978-0131872486.
3. Scott Chacon & Ben Straub, Pro Git, 2nd Edition, 2014, Apress, ISBN: 978-1484200773.

### Website Links/ Online Resources

1. Core Java Programming Virtual Lab-IIT Delhi,  
<https://java-iitd.vlabs.ac.in/>
2. Fundamentals of OOP: Prof. Balasubramanian Raman, IIT Roorkee  
<https://nptel.ac.in/courses/106107574>
3. Programming In Java, Prof. Debasis Samanta, IIT Kharagpur,  
<https://nptel.ac.in/courses/106105191>

**4. Object-Oriented Programming Concepts- GeeksforGeeks**<https://www.geeksforgeeks.org/object-oriented-programming-oops-concept-in-java/>**5. OOP in Python- Programiz**<https://www.programiz.com/python-programming/object-oriented-programming>**6.Oracle Java Documentation- OOP Concepts**<https://docs.oracle.com/javase/tutorial/java/concepts/>**7. GitHub Documentation -Version control and collaborative software development.**<https://docs.github.com>**8. Git Official Documentation-Understanding Git concepts and commands.**<https://git-scm.com/docs>**9. Mini-projects: OOP Hackathon Problem Statement**<https://www.scribd.com/document/845429125/OOP-Hackathon>**10. Mini-projects: Hackathon Problem Statements**[https://unstop.com/api/competition/get-attachment/605c7cfe84fd7\\_Hackathon\\_Problem\\_Statements\\_.pdf](https://unstop.com/api/competition/get-attachment/605c7cfe84fd7_Hackathon_Problem_Statements_.pdf)**11. Mini-projects: UpGrad-Hackathon Project Ideas**<https://www.upgrad.com/blog/hackathon-project-ideas/>**Strength of CO-PO-PSO Mapping**

| CO  | PO1 | PO2 | PO3 | PO4  | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|------|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   | 2   | 1   | -    | 2   | -   | -   | 1   | 1   | -    | -    | 3    | 3    | 2    |
| CO2 | 3   | 3   | 2   | 2    | 2   | -   | -   | 1   | 1   | -    | -    | 3    | 3    | 2    |
| CO3 | 3   | 2   | 2   | 2    | 2   | -   | -   | 1   | 1   | -    | -    | 3    | 3    | 2    |
| CO4 | 2   | 2   | 2   | 3    | 3   | -   | -   | 1   | 2   | 1    | -    | 3    | 3    | 2    |
| CO5 | 2   | 2   | 2   | 2    | 3   | 1   | 1   | 2   | 2   | 2    | -    | 3    | 3    | 3    |
| Avg | 2.6 | 2.2 | 1.8 | 2.25 | 2.4 | 1   | 1   | 1.2 | 1.4 | 1.5  | -    | 3    | 3    | 2.2  |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Assessment Pattern**

| BT Level | CCE based on ARCV |        |       |       |       |       |       |       |        |             |
|----------|-------------------|--------|-------|-------|-------|-------|-------|-------|--------|-------------|
|          | Exp 1             | Exp 2  | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9  | Exp 10      |
| CO       | CO1               | CO-1,2 | CO2,3 | CO3   | CO3   | CO3   | CO4   | CO4   | CO 4,5 | CO1,2,3,4,5 |
| L1       | -                 | -      | -     | -     | -     | -     | -     | -     | -      | -           |
| L2       | ✓                 | ✓      | -     | -     | -     | -     | -     | -     | -      | ✓           |



|           |   |   |   |   |   |   |   |   |   |   |
|-----------|---|---|---|---|---|---|---|---|---|---|
| <b>L3</b> | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| <b>L4</b> | - | - | - | - | - | - | - | - | ✓ | ✓ |
| <b>L5</b> | - | - | - | - | - | - | - | - | - | - |
| <b>L6</b> | - | - | - | - | - | - | - | - | - | - |

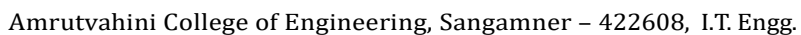
**This course serves as a prerequisite for maps with the following future courses:**

- Software Engineering
- Design and Analysis of Algorithms
- Advanced Java
- Web Technologies
- Full Stack Development
- Database Management Systems
- Final Year Project / Capstone Project.

### **Job Mapping:**

**Job/Future opportunities that one can get after learning this course:**

- Java Developer
- Software Developer
- Application Developer
- Android Developer
- Full Stack Developer
- Software Tester
- System Analyst
- Technical Consultant
- Higher Studies
- Entrepreneur / Startup Founder



### Course Description:

**Course Relevance:**

The course is relevant in today's technology-driven world where innovation, software development and digital content creation require legal protection. It helps students understand how intellectual property safeguards ideas, inventions and creative works. The knowledge of copyright and patent drafting supports careers in IT, legal consultancy, startups, and innovation management. The ethical awareness helps students to avoid infringement and promote responsible use of technology. The course also connects IPR with sustainable development and environmental responsibility, making it highly useful for modern professionals and associated societal issues.

**Prerequisite:**

- Basics IT and digital contents
- Awareness of software, websites,
- Communication and technical writing skills

### Bridge Content:

- Basics of innovation, software, websites and digital content.
- Ethical use of information and intellectual property.
- Technical documentation, innovation and startups.

### Course Objectives:

1. To provide fundamental knowledge of copyright and patent laws, filing procedures, and protection mechanisms with special reference to the IT domain in India.
2. To develop practical skills in drafting and filing basic copyright and patent documents in accordance with Indian intellectual property regulations.
3. To create awareness about ethical issues, infringement risks and commercialization strategies related to copyrights and patents in the modern innovation ecosystem.



4. To understand the role of Intellectual Property Rights (IPR) in sustainable development, environmental protection, green computing, and responsible technological innovation.

**Course Outcomes:** After learning the course, students will be able to

| CO  | Course Outcome                                                                                        | Bloom's Level |
|-----|-------------------------------------------------------------------------------------------------------|---------------|
| CO1 | <b>UNDERSTAND</b> the basic concepts of Intellectual Property Rights                                  | 2             |
| CO2 | <b>APPLY</b> Indian intellectual property laws to prepare filing the patent documents.                | 3             |
| CO3 | <b>ANALYZE</b> ethical issues related to copyrights and patents in the modern innovation environment. | 4             |
| CO4 | <b>UNDERSTAND</b> IPR in Sustainable Development and Environmental Issues                             | 2             |

### Course Contents

| Unit 1 | Copyright & Copyright Filing | 7 Hrs | CO1 |
|--------|------------------------------|-------|-----|
|--------|------------------------------|-------|-----|

**Introduction to Copyright:** Meaning, Definition and need of Copyright, Role of IPR in Information Technology industry, Types of IPR (Patents, Copyrights, Trademarks, Designs, Geographical Indications, Trade Secrets), Works Protected under Copyright Law, Ownership of Copyright, Duration of Protection

**Rights of Copyright Holder:** Economic Rights, Moral Rights, Reproduction and Distribution Rights

**Copyright Registration Process:** Need for Registration, Eligibility for Filing, Steps in Copyright Filing in India (Preparation of Work / Material, Filing Application, Submission of Statement of Particulars, Payment of Fees, Examination & Objection Handling, Registration Certificate), Documents Required, Online Filing Procedure, International Copyright Protection & Filing

**Copyright in IT Domain:** Software Copyright, Website & App Content Protection, Licensing & Assignment

### Exemplars/Case studies/Practical Applications and usage:

- 1: Copyright registration of a software application including source code, UI design, and database structure for legal ownership protection.
2. Protection of website content, digital learning material and multimedia assets through copyright filing and licensing.

| Unit 2 | Patent & Patent Filing | 8 Hrs. | CO2 |
|--------|------------------------|--------|-----|
|--------|------------------------|--------|-----|

**Introduction to Patents:** Meaning and Definition, Importance of Patents in Technology and Innovation, Patentable versus Non-Patentable Inventions

**Patentability Criteria and Types of Patent Applications:**



**Patentability Criteria:** Novelty, Inventive Step, Industrial Applicability, Patentable and Non-Patentable Subject Matter, Types of Patent Applications: Provisional Specification, Complete Specification, Ordinary and Convention Applications

**Structure of Patent Document and Patent Issues in IT:**

Structure of Patent Document: Title of Invention, Abstract, Background, Detailed Description, Claims, Drawings, Patent Issues in IT: Awareness of Software Patents, Patentability Challenges in Algorithms and Business Methods

**Patent Filing Process:** Steps in patent Filing in India (Invention Disclosure, Prior Art / Patent Search, Drafting Specification, Filing Application, Publication, Examination Request, Grant / Rejection), Required Forms & Fees, Role of Patent Agent, International Patent Filing Process.

**Exemplars/Case studies/Practical Applications and usage:**

1. Patent drafting for an IoT-based smart monitoring system with abstract, claims and technical description
2. Patentability assessment of an AI-based automation tool using novelty, inventive step and industrial applicability.

|               |                                                 |               |            |
|---------------|-------------------------------------------------|---------------|------------|
| <b>Unit 3</b> | <b>Ethical Issues in Copyrights and Patents</b> | <b>7 Hrs.</b> | <b>CO3</b> |
|---------------|-------------------------------------------------|---------------|------------|

**Ethical Issues in Copyright, Patent Protection:**

Ethical Issues in Copyright: Plagiarism in academic and software development, Fair use versus infringement, Piracy and digital copying, Open-source licensing and ethical compliance, Remedies and Penalties

**Ethics in Patent Protection and Patent Infringement**

Ethics in Patent Protection: Patent trolling, Misuse of patents, Ethical responsibility in research and innovation, Confidentiality and trade secrets, Patent Infringement: Types of infringement, Legal remedies, Compulsory licensing, Revocation of patent

**Technology Transfer & Commercialization**

Licensing agreements, Royalty models, Startup IP strategy, IP valuation basics

**Advances in IP Laws and Government policies**

Amendments and India's New National IP Policy, Promoting IPR policy for Start-ups, Career Opportunities in IP-IPR in current scenario

**Exemplars/Case studies/Practical Applications and usage**

1. Drafting a sample patent for a simple IT-based innovation following all ethical issues.
2. Drafting copyright for software or digital content following all ethical issues.

|               |                                                                     |              |            |
|---------------|---------------------------------------------------------------------|--------------|------------|
| <b>Unit 4</b> | <b>IPR in Sustainable Technologies and Environmental Protection</b> | <b>8 Hrs</b> | <b>CO4</b> |
|---------------|---------------------------------------------------------------------|--------------|------------|

**Introduction to Sustainable Development and IPR:**

Relationship between Intellectual Property Rights (IPR) and sustainable development, Role of IPR in Industry, Innovation, Infrastructure and Climate Action, Importance of sustainable technologies in modern society



### **IPR and Environmental Issues:**

Protection of environmental awareness content and digital resources, IPR in Green Energy Technologies, E-Waste Management and Smart Waste Segregation Solutions, IPR support for innovations related to clean water, sanitation and sustainable communities, Protection of digital educational resources and sustainability awareness platforms for Quality Education

### **Green Computing and Sustainable IT:**

Importance of sustainable software development practices, Cloud computing and virtualization for reducing environmental impact, Eco-friendly IT infrastructure and data centres, Green computing practices supporting energy efficiency, affordable and clean energy, Sustainable IT solutions for social welfare, healthcare and smart digital ecosystems

### **Exemplars/Case studies/Practical Applications and usage:**

1. IP protection for green computing solutions such as energy-efficient cloud infrastructure and virtualization.
2. Copyright and patent applications in smart waste management and environmental monitoring systems.

### **Textbooks:**

1. Rockman, Howard B, Intellectual Property Law for Engineers, Scientists, and Entrepreneurs, 2nd Edition, 2020, John Wiley & Sons, ISBN: 1119381975
2. Sople, Vinod V., Managing Intellectual Property: The Strategic Imperative, 5th Edition, 2016, PHI Learning, ISBN: 9788120352650
3. Durafe, Asha Vijay & Toradmalle, Dhanashree K., Intellectual Property Rights, 2020, Wiley India, ISBN: 9789390395910.

### **Reference Books:**

1. Ahuja, V. K., Law Relating to Intellectual Property Rights, 3rd Edition, 2017, LexisNexis India, ISBN: 9788131251652
2. Dutfield, Graham & Suthersanen, Uma, on Global Intellectual Property Law, 2nd Edition, 2020, Edward Elgar Publishing, ISBN: 9781782548843
3. J.P. Mishra, An Introduction to Intellectual Property Rights, 3rd Edition, 2012, Central Law Publications, New Delhi, ISBN: 938129254X.

### **Website Links/ Online Resources**

1. **Introduction On Intellectual Property to Engineers and Technologists: Prof. Tapas Kumar Bandyopadhyay, IIT Kharagpur,**  
<https://nptel.ac.in/courses/109105112>



**2.Copyright Office-Government of India: official portal for copyright law, forms, process & fees.**

<https://copyright.gov.in/>

**3.Copyright Office-Government of India: Workflow & E-Filing Guidance: procedure & workflow details for filing.**

<https://copyright.gov.in/frmWorkFlow.aspx>

**4.Patent-India:Intellectual Property India-Official IPR Portal: patents, trademarks, designs**

<https://ipindia.gov.in/>

**5.Patent Forms & Fees: downloading application & fee schedule**

[https://ipindia.gov.in/Patents/form\\_and\\_fees](https://ipindia.gov.in/Patents/form_and_fees)

**6. Journal of Intellectual Property Rights (JIPR)** by National Institute of Science Communication and Information Resources (NISCAIR), Council of Scientific & Industrial Research (CSIR), Government of India,2025(yearly), ISSN: 0975-1076

<https://nopr.niscpr.res.in/handle/123456789/31>

**7.World Intellectual Property Organization:**

<https://www.wipo.int/about-ip/en/>

**8.Introduction To IPR: Dr. Eknath Bayas**

<https://amzn.in/d/0jaAMPmZ>

**9.Introduction to Environmental Engineering and Science-Fundamental and Sustainability Concepts: By Prof. Brajesh Kr. Dubey, IIT Kharagpur**

[https://onlinecourses.nptel.ac.in/noc23\\_ge17/preview](https://onlinecourses.nptel.ac.in/noc23_ge17/preview)

## CO-PO Mapping

| CO   | PO1  | PO2 | PO3 | PO4 | PO5  | PO6 | PO7  | PO8  | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|------|-----|-----|-----|------|-----|------|------|-----|------|------|------|------|------|
| CO1  | 2    | 2   | 2   | 1   | 2    | 1   | 2    | 1    | 2   | -    | 2    | 2    | 2    | 1    |
| CO2  | 3    | 3   | 3   | 2   | 2    | 1   | 2    | 1    | 2   | -    | 2    | 3    | 3    | 2    |
| CO3  | 1    | 2   | 2   | 1   | 1    | 3   | 3    | 2    | 2   | -    | 2    | 1    | 2    | 3    |
| CO4  | 2    | 2   | 3   | 1   | 2    | 3   | 2    | 1    | 1   | -    | 2    | 2    | 2    | 2    |
| Avg. | 2.25 | 2.5 | 2.5 | 1.5 | 1.75 | 1.5 | 2.25 | 1.25 | 2   | -    | 2    | 2.25 | 2.5  | 2    |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Assessment Pattern**

| BT<br>Level | CCE       |           |           |           | ESE       |           |           |           |
|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|             | CO1<br>10 | CO2<br>10 | CO3<br>10 | CO4<br>10 | CO1<br>15 | CO2<br>15 | CO3<br>15 | CO4<br>15 |
| L1          | —         | —         | —         | —         | —         | —         | —         | —         |
| L2          | √         | —         | —         | √         | √         | —         | —         | √         |
| L3          | —         | √         | —         | —         | —         | √         | —         | —         |
| L4          | —         | —         | √         | —         | —         | —         | √         | —         |
| L5          | —         | —         | —         | —         | —         | —         | —         | —         |
| L6          | —         | —         | —         | —         | —         | —         | —         | —         |

**This course serves as a prerequisite for / maps with the following future courses**

- Software Engineering
- Project Based Learning
- Major Project / Capstone Project
- Data Analytics
- Entrepreneurship and Innovation

**Job / Future Opportunities after learning this course**

- Software Developer
- Data Analyst
- Social Innovation Engineer
- Project Coordinator
- Community Technology Consultant
- Startup Founder / Entrepreneur in Technology Domain