# Autonomy Scheme

# SJCEM R – 25 and R-24 ('C' SCHEME)

| Sr. No. | Heading | Particulars |
|---|---|---|
| 1 | **Title of the Course** | **Computer Engineering** |
| 2 | **Eligibility for Admission** | As per the Institute Examination Ordinance |
| 3 | **Theory Passing Marks (IAE / ESE)** | 40% |
| 4 | **Continuous Assessment (CA) / Oral / Practical** | 50% |
| 5 | **To be implemented from Academic Year** | With effect from Academic Year: 2025-2026 |
| 6 | **Total Credits** | Maximum 173 |
| 7 | **Honor / Minor Course offered** | **Data Science** (Additional Credits: 18) |
| 8 | **Eligibility Criteria for Honor / Minor** | • Students with no backlogs in semester I, II and III<br>• The CGPI based on semester I, II and III of the student must be 6.75 and above<br>• For Direct Second Year (DSE) students – No backlog in semester III and CGPI must be 6.75 and above |

# Preface

University Grant Commission vide Letter No. F. 2–10/2023 (AC–Policy) dated 19th January 2024 conferred the autonomous status to St. John College of Engineering and Management, Village Vevoor, Manor Road, Palghar (East), 401404 affiliated to University of Mumbai for a period of 10 years from the academic year 2024-2025 to 2033-2034 as per clause 7.5 of the UGC (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations 2023. Designing the curriculum as an autonomous institution raises challenges pertaining to maintaining quality engineering education.

Systematic approach has been adapted in the design and implementation of curriculum with the intent of ensuring quality education catering to the sensitive needs of a learner, society, and industry. The curriculum is aligned with NEP and UGC guidelines as per Government of Maharashtra guidelines for autonomous institutions Government Resolution dated 4th July 2023. Based on recent recommendations of the GR, holistic curriculum for 2024-28, a "H-Tree Model" of Engineering Education is offered. A unique "H-Tree Model" of Engineering Education Curriculum is followed and curriculum is designed to systematically develop IQ (Intelligence Quotient), PQ (Physical Quotient), EQ (Emotional Quotient), and SQ (Spiritual Quotient) of a learner. This curriculum aims at the development of an all-rounded personality with holistic approach to education in which a learner receives 34% teacher-led learning, 15% peer learning, 26% self-learning, and 25% experiential learning. The curriculum model is outcome based that focuses on learning by doing. Curriculum is designed to provide multiple learning opportunities for students to acquire and demonstrate competencies for rewarding careers. It ensures multiple choices to a leaner acquiring skills through systematic planning. It has 7 verticals aligned to GR recommendations with strong science and mathematics foundation and program core, sequel of electives, multidisciplinary minor courses, humanities & management courses, and sufficient experiential learning through projects and semester-long industry/research internship along with employable skill-based courses. A learner gets an opportunity to acquire skills through NSDC aligned courses during summer vacations. Additional options of choosing from Honors/Double Minor / Honors with Research are also provided to a learner.

The curriculum balances contact hours and total credits of the entire program. The total credits are 172, wherein focus is not only on providing knowledge but also on building skills, attitude and self-learning. Therefore, in the present curriculum, skill-based laboratories, mini- projects, multi-disciplinary projects, and internships are made mandatory across all disciplines of engineering, which will definitely facilitate self-learning of students. The overall credits and approach of curriculum proposed in the scheme and syllabus are in line with AICTE model curriculum. SJCEM R-25 and R-24C curriculum will be implemented for Computer Engineering from the academic year 2026-27.

# Nomenclature

| Abbreviation | Title |
|---|---|
| BSC | Basic Science Courses |
| ESC | Engineering Science Courses |
| PCC | Program Core Courses |
| PEC | Program Elective Courses |
| MDM | Multidisciplinary Minor |
| OE | Open Elective |
| SC | Skill Courses |
| LLC | Liberal Learning Courses |
| VSEC | Vocational and Skill Enhancement Course |
| VEC | Value Education Course |
| SEC | Skill Enhancement Courses |
| AEC | Ability Enhancement Course |
| IKS | Indian Knowledge System |
| CC | Co-curricular Courses |

## Credit Specification:

- Theory: 1 credit = 15 hours of teaching
- Lab: 1 Credit = 30 hours of lab work.
- Workshop Based Activities: 1 Credit = 30 hours of hands-on activities related to vocation/professional practice/skill based
- Seminar/Group Discussion: 1 Credit = 15 hours of participation
- Community Engagement Projects: 1 Credit = 30 hours of contact time along with 15 hours of activities preparation, report writing, independent reading etc.

Dr. Sunny Sall
BoS Chairman

Dr. Kamal Shah
Principal

St. John College of Engineering and Management
Autonomous Institute
(A Christian Religious Minority Institution)
Approved by AICTE and DTE, Affiliated to University of Mumbai / MSBTE
DTE Code : 3218 AICTE Permanent ID : 1-4790201
NAAC Accredited with Grade 'A+', Three Programs NBA Accredited

# Bachelor of Technology
# In
# Computer Engineering

## Second Year

**Semester – III**

SJCEM R–25 SCHEME

**Effective from Academic Year 2025-26**

# Program Structure for Second Year Computer Engineering

**Semester – III**
**SCHEME: SJCEM R-25 Scheme**
**(With Effect from 2026-27)**

| Course Code | Vertical | Course Name | Contact Hrs. | | | Credit Allotted | | | Total Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | Th | Tut | Pr | Th | Tut | Pr | |
| 25CSPCC301 | PCC | Discrete Mathematics | 3 | 1 | - | 3 | 1 | - | 4 |
| 25CSPCC302 | PCC | Data Structures | 3 | - | 2 | 3 | - | 1 | 4 |
| 25CSPCC303 | PCC | Microprocessor & Computer Architecture | 3 | - | 2 | 3 | - | 1 | 4 |
| 25CSPCC304 | PCC | Database Management System | 3 | - | 2 | 3 | - | 1 | 4 |
| 25CSPCC305 | PCC | Programming Language I | 1 | - | 2 | 1 | - | 1 | 2 |
| 25CSVEC301 | VEC | Universal Human Values | 2 | 1 | - | 2 | 1 | - | 3 |
| 25CSAEC301 | AEC | Employability Enhancement Program -I (Communication) | - | 1 | - | - | 1 | - | 1 |
| | | **Total** | **15** | **03** | **08** | **15** | **03** | **04** | **22** |

| Course Code | Vertical | Course Name | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| 25CSPCC301 | PCC | Discrete Mathematics | 20 | 20 | 60 | 25 | - | 125 |
| 25CSPCC302 | PCC | Data Structures | 20 | 20 | 60 | 25 | 25 | 150 |
| 25CSPCC303 | PCC | Microprocessor & Computer Architecture | 20 | 20 | 60 | 25 | - | 125 |
| 25CSPCC304 | PCC | Database Management System | 20 | 20 | 60 | 25 | 25 | 150 |
| 25CSPCC305 | PCC | Programming Language I | 10 | 10 | 30 | 50 | 25 | 125 |
| 25CSVEC301 | VEC | Universal Human Values | 10 | 10 | 30 | 25 | - | 75 |
| 25CSAEC301 | AEC | Employability Enhancement Program -I (Communication) | - | - | - | 25 | - | 25 |
| | | **Total** | **100** | **100** | **300** | **200** | **75** | **775** |

| Course Title: Discrete Mathematics | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: III | | | Term: ODD | | | | Course Code: 25CSPCC301 | | | | | |
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credits | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 3 | 1 | - | 3 | 1 | - | 4 | 20 | 20 | 60 | 25 | - | 125 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment

**Course Objectives:** The course is aimed

1. To cultivate clear thinking and creative problem solving.
2. To define functions and distinguish between functions and relations.
3. Define partial order relations and lattices, and understand their properties.
4. Define orthogonal sets and orthonormal bases and understand their importance in applications such as signal processing and linear algebra.
5. To study the Matrix algebra and its application in Engineering Problems.
6. To understand the concept of Fourier series and enhance the problem solving skills.

**Course Outcomes:**

After completion of the course, learner will be able to:

1. Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving.
2. Define and differentiate between relations and functions, and identify different types of functions.
3. Apply concepts of lattices to solve problems in various areas, such as discrete mathematics, computer science, and order theory.
4. Define the inner product of vectors, orthogonal bases.
5. Apply the concepts of eigenvalues and eigenvectors to solve engineering problems.
6. Demonstrate the Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing and field theory.

| Module | Contents | Hours | COs |
|---|---|---|---|
| I | **Logic** | 7 | CO1 |
| | Propositional Logic, Predicate Logic, Laws of Logic, Duality, Quantifiers, Binary Predicates, Mathematical Induction.<br><br>**Self-learning Topics:** Normal Forms, Inference Theory of Predicate Calculus | | |
| II | **Relations and Functions** | 8 | CO2 |
| | Basic concepts of Set Theory,<br>**Relations:** Definition, Types of Relations, Representation of Relations, Closures of Relations, Warshall's algorithm, Equivalence relations and Equivalence Classes.<br>**Functions:** Definition, Types of functions, Composition of functions, Identity and Inverse function<br><br>**Self-learning Topics:** Operations on Relations- complementary relation, Inverse relation, Intersection and Union | | |
| III | **Posets and Lattice** | 8 | CO3 |
| | Partial Order Relations, Poset, Supremum and Infimum, Hasse Diagram, Lattice, Types of Lattice- Sub -lattice, Distributive lattice.<br><br>**Self-learning Topics:** Dual of Poset, Dual in a Lattice, Bounded lattice, Complemented lattice | | |
| IV | **Linear Algebra-I** | 7 | CO4 |
| | Vector Arithmetic, Norm, Euclidean Inner Product, Unit vector, Angle between two vectors, Cauchy-Schwarz Inequality, Orthogonality, Orthogonal Set, Orthonormal set, Gram-Schmidt Process<br><br>**Self-learning Topics:** Orthogonal Projection | | |
| V | **Linear Algebra-II** | 8 | CO5 |
| | Characteristic Equation, Eigenvalues and Eigenvectors and properties (without proof), Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials, Similarity of matrices, diagonalizable and non-diagonalizable matrices<br><br>**Self-learning Topics:** Derogatory and non-derogatory matrices, Functions of Square Matrix, Linear Transformations, Quadratic forms. | | |
| VI | **Fourier Series** | 7 | CO6 |
| | Dirichlet's conditions, Definition of Fourier series, Fourier series of periodic functions with period 2 and 2l, Fourier series of even and odd functions, Half range Sine and Cosine Series.<br><br>**Self-learning Topics:** Parseval's Identity, Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform. | | |
| | **Total** | **45** | |

## Evaluation Scheme and Assessment:

**A. Internal Assessment Examination:**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination:**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any Other

**Note:** Number of activities to be conducted under TAE would be as per the subject need.

**D. Oral & Practical Exam:**

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Advanced Engineering Mathematics, C. Ray Wylie, Louis C. Barrett, McGraw- Hill Book Co., New York, 6th Edition.
2. Y N Singh, "Discrete Mathematical Structures", Wiley-India

**Text Books:**

1. Higher Engineering Mathematics, Dr. B .S. Grewal, Khanna Publication, 44th Edition.
2. Linear Algebra & its applications, David C. Lay, Pearson Publication, 3rd Edition.
3. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, "Discrete Mathematical Structures", Pearson Education.

**Useful Links**

1. https://www.edx.org/learn/discrete-mathematics
2. https://www.coursera.org/specializations/discrete-mathematics
3. https://nptel.ac.in/courses/106/106/106106094/

| Course Title: Data Structures | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: III | | | Term: ODD | | | | Course Code: 25CSPCC302 | | | | | |
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 3 | - | 2 | 3 | - | 1 | 4 | 20 | 20 | 60 | 25 | 25 | 150 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment

## Course Objectives: The course aims

1. To understand the standard and abstract data representation methods.
2. To acquaint with the structural constraints and advantages in usage of the data.
3. To understand the memory requirement for various data structures.
4. To operate on the various structured data.
5. To understand various data searching and sorting methods with pros and cons.
6. To understand various algorithmic strategies to approach the problem solution.

## Course Outcomes:

At the end of the course students will be able:

1. To implement linear and Non-Linear data structures and explain various data structures related terminologies and its types.
2. To design the algorithms using stacks and queues to solve the programming problems.
3. To choose appropriate data structure in linked list and apply it to solve problems in various domains.
4. To describe and apply operations like insertion, deletion, searching and traversing on tree data structure.
5. To describe and apply operations like insertion, deletion, searching and traversing on graph data structure.
6. To select appropriate searching and/or sorting techniques in the application development.

**Prerequisite:** Basic Programming syntax of C. Functions in C. Pointers in C, dynamic memory allocation, pointer to pointe, pointer to functions.

| Module | Contents | Hours | Cos |
|---|---|---|---|
| I | **Introduction to Data Structures:** | 5 | CO1 |
| | Concept of ADT, Types of Data Structures- Linear and Nonlinear, Operations on Data Structures. Arrays, Multidimensional Arrays, Array of Pointers, String Manipulation.<br><br>**Self-Learning:** Structures with pointers | | |
| II | **Stack and Queues:** | 9 | CO2 |
| | **Stack:** Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack-Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation, Recursion. **Queue:** Introduction, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, Introduction of Double Ended Queue, Applications of Queue.<br><br>**Self-learning:** Implementation of stack and queue using structure | | |
| III | **Linked List:** | 9 | CO3 |
| | Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List, Circular Linked List, Doubly Linked List, Operations on Singly Linked List and Doubly Linked List, Stack and Queue using Singly Linked List,<br><br>**Self-Learning:** Singly Linked List Application-Polynomial Representation and Addition. | | |
| IV | **Trees:** | 9 | CO4 |
| | Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree, Applications of Binary Tree-Expression Tree, Huffman Encoding, Search Trees-AVL, rotations in AVL Tree, operations on AVL Tree, Introduction of B Tree, B+ Tree.<br><br>**Self-Learning:** Red-Black trees | | |
| V | **Graphs:** | 5 | CO5 |
| | Introduction, Graph Terminologies, Representation of Graph, Graph Traversals - Depth First Search (DFS) and Breadth First Search (BFS),<br><br>**Self-Learning:** Graph Application- Topological Sorting. | | |
| VI | **Sorting and Searching Techniques:** | 8 | CO6 |
| | Sorting Techniques: Bubble sort, insertion sort, selection sort<br>Searching Techniques: Linear Search, Binary Search<br>Hashing-Concept, Hash Functions, Collision resolution Techniques<br><br>**Self-Learning:** Merge sort and quick sort. | | |
| | **Total** | **45** | |

## List of Experiments

| Exp. No. | List of Experiments | Cos |
|---|---|---|
| 1 | Implement Stack ADT using array. | CO1, CO2 |
| 2 | Convert an Infix expression to Postfix expression using stack ADT. | CO2 |
| 3 | Evaluate Postfix Expression using Stack ADT. | CO2 |
| 4 | Implement Linear Queue ADT using array. | CO2 |
| 5 | Implement Circular Queue ADT using array. | CO2 |
| 6 | Implement Priority Queue ADT using array. | CO2 |
| 7 | Implement Singly Linked List ADT. | CO3 |
| 8 | Implement Circular Linked List ADT. | CO3 |
| 9 | Implement Doubly Linked List ADT. | CO3 |
| 10 | Implement Stack / Linear Queue ADT using Linked List. | CO3 |
| 11* | Implement Binary Search Tree ADT using Linked List. | CO4 |
| 12* | Implement Graph Traversal techniques:<br>a) Depth First Search b) Breadth First Search | CO5 |
| 13 | Applications of Binary Search Technique. | CO6 |
| 14 | Implement of Selection and Bubble Sort | CO6 |
| 15 | Implement of Merge / Quick Sort | CO6 |

## Evaluation and Assessment Scheme:

**A. Internal Assessment Examination (IAE):**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA) :**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate

4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

**D. Oral & Practical Exam:**

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Rajesh K Shukla, "Data Structures using C and C++", Wiley-India
2. Balagurusamy, "Data Structure Using C", Tata McGraw-Hill Education India.
3. Robert Kruse, C. L. Tondo, Bruce Leung, "Data Structures and Program Design in C", Pearson Edition.
4. Prof. P. S. Deshpande, Prof. O. G. Kakde, "C and Data Structures", DreamTech press.

**Text Books:**

1. Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, "Data Structures Using C", Pearson Publication.
2. Jean Paul Tremblay, P. G. Sorenson, "Introduction to Data Structure and Its Applications", McGraw- Hill Higher Education
3. Richard F. Gilberg and Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", 2ndEdition, CENGAGE Learning.
4. Data Structures Using C, ISRD Group, 2ndEdition, Tata McGraw-Hill.

**Useful Links**

1. https://swayam.gov.in/nd1_noc19_cs67/preview
2. https://nptel.ac.in/courses/106/102/106102064/
3. https://www.edx.org/course/data-structures-fundamentals

| Course Title: Microprocessor and Computer Architecture | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: III | | | Term: ODD | | | | Course Code: 25CSPCC303 | | | | | |
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 3 | - | 2 | 3 | - | 1 | 4 | 20 | 20 | 60 | 25 | - | 125 |

IAE: Internal Assessment
Examination ESE: End Semester
Examination
CA: Continuous Assessment

## Course Objectives:

1. To conceptualize the basics of organizational and features of a digital computer.
2. To study microprocessor architecture and assembly language programming.
3. To equip students with the fundamental knowledge and basic technical competence in the field of Microprocessors.
4. To emphasize on instruction set and logic to build assembly language programs.
5. To prepare students for higher processor architectures and embedded systems.

## Course Outcomes:

At the end of the course students will be able to:

1. Describe basic organization of computer and the architecture of 8086 microprocessor and implement assembly language programming for 8086 microprocessors.
2. Describe different control unit design methods and conceptualize instruction level parallelism.
3. Describe core concepts of 8086 microprocessor.
4. Identify the specifications of peripheral chip.
5. Design 8086 based system using memory and peripheral chips and explain the architecture of advanced processors.
6. Describe hyper threading technology.

| Module | Contents | Hours | COs |
|---|---|---|---|
| I | **Overview of Computer architecture and Organization** | 5 | CO1 |
| | Introduction of Computer Organization and Architecture, Von Neumann Model, Performance Measure of Computer Architecture. Architecture of 8086 Family, Instruction Set, Addressing Modes.<br><br>**Self-learning Topics:** Basic Organization of Computer and Block Level Description of the Functional Units, Evolution of Computers | | |
| II | **Processor organization and architecture** | 7 | CO2 |
| | CPU Architecture, Instruction Formats, Basic Instruction Cycle with Interrupt Processing.<br>Control Unit: Soft Wired (Microprogrammed) and Hardwired Control Unit. Microinstruction Sequencing and Execution, Micro Operations, Introduction to Parallel Processing Concepts, Flynn's Classifications, Instruction Pipelining, Pipeline Hazards.<br><br>**Self-learning Topics:** Instruction Interpretation and Sequencing, Concepts of Nano Programming. | | |
| III | **The Intel microprocessors 8086 architecture** | 8 | CO3 |
| | 8086CPU Architecture, Programmer's Model, Functional Pin Diagram. Memory Segmentation, Banking in 8086, Functioning of 8086 in Minimum mode and Maximum mode.<br>Timing diagrams for Read and Write operations in minimum and maximum mode.<br><br>**Self-learning Topics:** De-multiplexing of Address/Data bus**,** Interrupt structure and its servicing. | | |
| IV | **Memory and peripherals Interfacing** | 10 | CO4 |
| | Memory Interfacing - RAM and ROM Decoding, 8255-PPI-Block diagram, CWR, operating modes, interfacing with 8086.<br>8257-DMAC-Block diagram, DMA operations and transfer modes. Programmable Interrupt Controller 8259-Block Diagram.<br><br>**Self-learning Topics:** Techniques Partial and Absolute, Interfacing the 8259 in single and cascaded mode. | | |
| V | **80386Dx processor and Pentium processor** | 10 | CO5 |
| | Architecture of 80386 microprocessor.<br>80386 registers-General purpose Registers, EFLAGS and Control registers. Real mode, Protected mode, virtual 8086 mode.<br>Pentium Architecture, Superscalar Operation, Integer &Floating-Point. Pipeline Stages, Branch Prediction Logic.<br><br>**Self-learning Topics:** 80386 memory management in Protected Mode – Descriptors and selectors, descriptor tables, the memory paging mechanism, Cache Organization and MESI protocol. | | |
| VI | **Pentium 4 and ARM processor** | 5 | CO6 |

| | | | |
|---|---|---|---|
| | Comparative study of 8086, 80386, Pentium 1, Pentium II and Pentium. Pentium 4: Net burst micro architecture.<br>Instruction translation look aside buffer and branch prediction, Hyper threading technology and its use in Pentium 4,<br>Recap of modules, Outcomes, Applications and summarization.<br><br>**Self-learning Topics:** Application and Features of ARM processors. | | |
| | **Total** | **45** | |

## List of Experiments

| Exp. No. | List of Experiments | COs |
|---|---|---|
| 1 | Use of programming tools (Debug/TASM/MASM/8086kit) to perform basic arithmetic operations on 8-bit/16-bit data. | CO1 |
| 2 | Assembly programming for 16-bit addition, subtraction, multiplication and division (menu based) | CO1, CO2 |
| 3 | Assembly program based on string instructions (overlapping/non-overlapping block transfer/ string search/ string length). | CO1, CO2 |
| 4 | Assembly program to display the contents of the flag register. | CO2, CO3 |
| 5 | Any Mixed Language programs. | CO2, CO3 |
| 6 | Assembly program to sort numbers in ascending/ descending order. | CO3, CO4 |
| 7 | Assembly program to find minimum/maximum number from a given array. | CO3, CO4 |
| 8 | Assembly program using macro. | CO4, CO5 |
| 9 | Program and interfacing using 8255. | CO5, CO6 |
| 10 | Program and interfacing of ADC/DAC/ Stepper motor. | CO5, CO6 |

## Evaluation and Assessment Scheme:

**A. Internal Assessment Examination (IAE):**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks
**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

**Reference Books:**

1. B. Govindarajulu, Computer Architecture and Organization: Design Principles and Applications.
2. Barry B. Brey, "Intel Microprocessors", 8th Edition, Pearson Education India.
3. James Antonakons, "The Pentium Microprocessor", Pearson Education
4. Douglas Hall, "Microprocessor and Interfacing", Tata McGraw Hill.

**Text Books:**

1. I. C. Hamacher, Z. Vranesic and S. Zaky, Computer Organization, McGraw Hill.
2. W. Stallings, Computer Organization and Architecture: Designing for Performance, Pearson
3. John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", PHI
4. Yu-Cheng Liu, Glenn A. Gibson, "Microcomputer System: The 8086/8088 Family, Architecture, Programming and Design", Prentice Hall
5. Walter A. Triebel, "The 80386DX Microprocessor: hardware, Software and Interfacing", Prentice Hall
6. Tom Shanley and Don Anderson, "Pentium Processor System.Architecture", Addison- Wesley.

**Useful Links**

1. https://nptel.ac.in/courses/106/105/106105163/
2. https://www.udemy.com/course/computer-organization-and-architecture-j/
3. https://nptel.ac.in/courses/108/105/108105102/
4. https://www.mooc-list.com/tags/microprocessors

| Course Title: Database Management System | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: III | | | Term: ODD | | | | Course Code: 24CSPCC304B | | | | | |
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 3 | - | 2 | 3 | - | 1 | 4 | 20 | 20 | 60 | 25 | 25 | 150 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment

## Course Objectives:

1. To explain the basic concepts and architecture of database systems.
2. To design Entity-Relationship (ER) models for real-world applications.
3. To apply relational algebra for query processing.
4. To demonstrate the use of SQL for data definition and manipulation.
5. To analyze data dependencies and normalize database schemas.
6. To illustrate transaction management, concurrency control, and recovery mechanisms.

## Course Outcomes:

At the end of the course students will be able to:

1. Describe the structure, advantages, and functionalities of database systems.
2. Construct ER models and convert them into relational schemas.
3. Differentiate between various relational algebra operations and implement them.
4. Write SQL queries to perform CRUD operations and implement constraints.
5. Normalize relational schemas using functional and multivalued dependencies.
6. Assess the effects of transaction concurrency and apply appropriate control protocols.

| Module | Contents | Hours | Cos |
|---|---|---|---|
| I | **Module 1: Introduction to Databases and Data Models** | **6** | CO1 |
| | Characteristics of databases, DBMS vs. File System, Users of DBMS, Three-schema architecture.<br>Data models: Hierarchical, Network, Relational, Object-Oriented, Instances and Schemas, Data Independence<br><br>**Self-Learning Topics:** NoSQL Databases Overview | | |
| II | **Module 2: Entity-Relationship (ER) and Enhanced ER Model** | 6 | CO |
| | ER model concepts: entity, attributes, relationships,<br>Constraints, Keys, Generalization, Specialization, Aggregation,<br>Converting ER to Relational Model<br><br>**Self-Learning Topics:** UML Class Diagrams vs ER Diagrams | | |
| III | **Module 3: Relational Model and Relational Algebra** | 8 | CO3 |
| | Structure of relational databases, Domain, Tuples, Attributes,<br>Keys: Super, Candidate, Primary, Foreign<br>Relational Algebra operations: Select, Project, Join, Union, Set, Difference, Cartesian Product, Rename Extended Relational Algebra: Aggregate functions, Grouping<br><br>**Self-Learning Topics:** Relational Calculus (Tuple & Domain) | | |
| IV | **Module 4: SQL and Advanced SQL** | 9 | CO4 |
| | Basic SQL Queries: SELECT, INSERT, DELETE, UPDATE<br>Constraints: NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, CHECK<br>Joins: INNER, LEFT, RIGHT, FULL OUTER<br>Subqueries and Nested Queries<br>Views, Indexes<br>Transactions: COMMIT, ROLLBACK<br>Stored Procedures and Triggers (Concept only)<br><br>**Self-Learning Topics:** Stored Procedures and Triggers in MySQL/PostgreSQL | | |
| V | **Module 5: Normalization and Database Design** | 8 | CO5 |
| | Functional Dependencies<br>Normal Forms: 1NF, 2NF, 3NF, BCNF<br>Multivalued Dependencies and 4NF<br>Join Dependencies and 5NF (concept only)<br>Decomposition and Dependency Preservation<br><br>**Self-Learning Topics:** Denormalization Techniques | | |

| | | | |
|---|---|---|---|
| VI | **Module 6: Transaction Management and Concurrency Control** | 8 | CO6 |
| | Transaction Concepts and ACID properties<br>States of Transactions<br>Schedules: Serial, Serializable, Conflict Serializable<br>Lock-based protocols: Shared/Exclusive locks, Two-Phase Locking<br>Deadlock Detection and Prevention<br>Timestamp-based protocols<br>Recovery: Log-based, Checkpoints<br><br>**Self-Learning Topics:** Two-Phase Commit Protocol | | |
| | **Total** | **45** | |

## List of Experiments:

| Exp. No. | List of Experiments | Cos |
|---|---|---|
| 1 | ER Diagram Design: Design ER diagram for a university/library/hospital system. | CO1 |
| 2 | Convert ER Diagram into Relational Model | CO1, CO2 |
| 3 | Schema Creation**:** Write DDL queries to create tables with constraints. | CO1. CO2 |
| 4 | Simple Queries: Write DML and DQL commands. | CO2, CO3 |
| 5 | Joins**:** Use various types of joins on relational tables. | CO3, CO4 |
| 6 | Nested Queries and Subqueries | CO3. CO4 |
| 7 | Aggregate Functions with GROUP BY and HAVING | CO4, CO5 |
| 8 | Implementation of Triggers (basic level) | CO4, CO5 |
| 9 | Normalization**:** Convert an unnormalized relation to 1NF, 2NF, 3NF. | CO5, CO6 |
| 10 | Transaction Control**:** Demonstrate COMMIT and ROLLBACK. | CO5, CO6 |

## Evaluation and Assessment Scheme:

**A. Internal Assessment Examination (IAE):**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

**D. Oral & Practical Exam:**

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Elmasri and Navathe, Fundamentals of Database Systems, 6th Edition, Pearson education.
2. Korth, Slberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill.

**Text Books:**

1. An Introduction to Database System by C. J. Date Sixth Edition.
2. Database Systems the Complete Book by Jeffery D. Ullman Second Edition.

**Useful Links**

1. https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/
2. https://www.youtube.com/playlist?list=PL9ysvtVnryGpnIj9rcIqNDxakUn6v72Hm

| Course Title: Programming Language I (Python) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: III | | | Term: ODD | | | | Course Code: 25CSPCC305 | | | | | |
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 1 | - | 2 | 1 | - | 1 | 2 | 10 | 10 | 30 | 50 | 25 | 125 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment

## Course Objectives:

1. To introduce the fundamental concepts of Python programming.
2. To learn Python control flow with conditional statements and loops, creation and usage of functions.
3. To learn Object Oriented Programming concepts in python.
4. To learn Concepts of modules and packages in python.
5. To learn how to develop GUI-based applications using Python.
6. To equip students with the skills to handle email communication in Python.

## Course Outcomes:

At the end of the course students will be able to:

1. Understand the structure, syntax, semantics and data types of the Python language.
2. Familiarize with various control flow structures and function in Python.
3. Illustrate the concepts of object-oriented programming as used in Python.
4. Create Python applications using modules and packages.
5. Design GUI applications and evaluate database operations in python.
6. Develop Python scripts to send and receive emails using libraries.

| Module | Contents | Hours | Cos |
|---|---|---|---|
| 0 | **Prerequisite:** Basic Programming syntax of Java/C. Installation and configuration of python | | |
| I | **Basics of Python:** | 3 | CO1 |
| | Introduction, Basic & Built-in Math functions, Basic data types (Numeric, Boolean, Compound), Quotes, print() function, range() function, Tuples, Lists, Dictionaries, Sets, Numpy Arrays, Strings.<br><br>**Self-learning Topics:** Practical applications with combined data types. | | |
| II | **Control Statements and Function:** | 3 | CO2 |
| | Control flow statements: Conditional statements (if, if…else, nested if), Looping in Python (while loop, for loop, nested loops), Built-in functions in python, Defining a Function, Checking & Setting Your Parameters, Default arguments, Variable length arguments, Defining and calling functions within a function, Recursive functions, Anonymous Functions<br>(Lambda, Map, Reduce, Filter).<br><br>**Self-learning Topics:** Zip() function, Function decorators. | | |
| III | **Object Oriented Programming:** | 2 | CO3 |
| | Creating Classes and Objects, Self-Variable, Constructors, Inheritance, Polymorphism.<br><br>**Self-learning Topics:** Exceptions Handling, User Defined Exceptions. | | |
| IV | **Modules and Packages:** | 3 | CO4 |
| | Importing own module as well as external modules, Understanding Packages, modules and external packages, Opening and Reading Files and Folders (Python OS Module,<br>Python Datetime Module, Python Math and Random Modules).<br><br>**Self-learning Topics:** Regular expression in python, Text Processing. | | |
| V | **GUI Programming with Database Connectivity:** | 2 | CO5 |
| | GUI Programming Toolkits, Creating GUI Widgets with Tkinter, Creating Layouts, Form Components, Dialog Boxes.<br>Types of Databases used with Python, Mysql database Connectivity with Python, Performing DML operations on database.<br><br>**Self-learning Topics:** File handling, Pickle in Python. | | |
| VI | **Advanced Python:** | 2 | CO6 |
| | Emails with Python: Introduction to Emails with Python, Sending Emails with Python, Receiving Emails with Python.<br><br>**Self-learning Topics:** Networking in Python: Client Server socket programming. | | |
| | **Total** | **15** | |

## List of Experiments:

| Exp. No. | List of Experiments | Cos |
|---|---|---|
| 1 | Write python programs to understand Expressions, Variables, Quotes, Basic Math operations. | CO1 |
| 2 | Write a Python program to implement Basic String Operations & String Methods. | CO1 |
| 3 | Write a Python program to implement functions of List, Tuples, and Dictionaries. | CO1 |
| 4 | Write a Python program to implement Arrays / Numpy Array (1D, 2D) applications. | CO1 |
| 5 | Write python programs to demonstrate applications of different decision-making statements. | CO2 |
| 6 | Write a Python program to implement Functions and Recursion. | CO2 |
| 7 | Write a Python program to implement Programs based on Lambda, Map and Reduce Functions. | CO2 |
| 8 | Write python programs to implement Classes & objects, Constructors. | CO3 |
| 9 | Write python programs to implement Inheritance & Polymorphism. | CO3 |
| 10 | Write python programs to create user-defined modules/packages and import them in a program. | CO4 |
| 11 | Write python programs to understand GUI designing and database operations (Programs based on GUI designing using Tkinter, Mysql database creation & Database connectivity with DML). | CO5 |
| 12 | Write python program to implement sending automated emails with Python. | CO6 |

## Evaluation and Assessment Scheme:

**A. Internal Assessment Examination (IAE):**
Assessment consists of two class tests, each 10 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**
End Semester exam of 30 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**
Continuous Assessment should consist of the following
**Experiments / Tutorials (8 to 10):** 25 marks (All COs / LOs should be covered)
**Attendance (Theory & Practical):** 05 marks
**Teacher Assessment Examination (TAE):** 20 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

**D. Oral & Practical Exam:**

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Zed A. Shaw, "Learn Python 3 the Hard Way", Zed Shaw's Hard Way Series.
2. Martin C. Brown," Python: The Complete Reference", McGraw-Hill Publication.
3. Paul Barry," Head First Python", 2nd Edition, O'Reilly Media, Inc.

**Text Books:**

1. Dr. R. Nageswara Rao," Core Python Programming" , Dreamtech Press, Wiley Publication
2. M. T. Savaliya , R. K. Maurya, "Programming through Python", StarEdu Solutions.
3. E Balagurusamy, "Introduction to computing and problem-solving using python", McGraw Hill Publication.

**Useful Links**

1. https://onlinecourses.swayam2.ac.in/cec22_cs20/preview
2. http://docs.python.org/release/3.0.1/tutorial/
3. http://spoken-tutorial.org
4. www.staredusolutions.org
5. https://www.tutorialspoint.com/python/index.htm

| Course Title: Universal Human Values | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: III | | | Term: ODD | | | Course Code: 25CSVEC301 | | | | | | |
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 2 | 1 | - | 2 | 1 | - | 3 | 10 | 10 | 30 | 25 | - | 75 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment

## Course Objectives:

1. To become more aware of themselves, and their surroundings (family, society, nature).
2. To become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. To become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
4. To apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

## Course Outcomes:

At the end of the course students will be able:

1. To appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To development of a Holistic perspective amongstudents towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To practice plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with nature.

| Module | Contents | Hours | Cos |
|---|---|---|---|
| I | **Introduction to Value Education** | 6 | CO1 |
| | • Understanding Value Education<br>• Self-exploration as the Process for Value Education- Continuous Happiness and Prosperity – the Basic Human Aspirations<br>• Right Understanding, Relationship and Physical Facility<br>• Happiness and Prosperity – Current Scenario<br>• Method to Fulfil the Basic Human Aspirations | | |
| II | **Harmony in the Human Being** | 6 | CO1 |
| | • Understanding Human being as the Co-existence of the Self and the Body<br>• Distinguishing between the Needs of the Self and the Body<br>• The Body as an Instrument of the Self<br>• Understanding Harmony in the Self<br>• Harmony of the Self with the Body<br>• Programme to Ensure self-regulation and Health | | |
| III | **Harmony in the Family and Society** | 6 | CO2 |
| | • Harmony in the Family – the Basic Unit of Human Interaction<br>• Values in Human-to-Human Relationship<br>• 'Trust' – the Foundational Value in Relationship<br>• 'Respect' – as the Right Evaluation<br>• Understanding Harmony in the Society<br>• Vision for the Universal Human Order | | |
| IV | **Harmony in the Nature (Existence)** | 5 | CO2 |
| | • Understanding Harmony in the Nature<br>• Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature<br>• Realizing Existence as Co-existence at All Levels<br>• The Holistic Perception of Harmony in Existence | | |
| V | **Implications of the Holistic Understanding** | 4 | CO3 |
| | • Natural access acceptance of Human Values<br>• Definitiveness of (Ethical) Human Conduct<br>• A Basis for Humanistic Education,<br>• Humanistic Constitution and Universal Human Order | | |
| VI | **Professional Ethics** | 3 | CO3 |
| | • Competence in Professional Ethics<br>• Holistic Technologies, Production Systems and Management Models-Typical Case Studies<br>• Strategies for Transition towards Value-based Life and **Profession** | | |
| | **Total** | **30** | |

## List of Tutorials

| Sr. No. | Topic | Hours. | COs |
|---|---|---|---|
| 1 | Sharing about oneself | 1 | CO1 |
| 2 | Exploring human consciousness | 1 | CO1 |
| 3 | Exploring natural acceptance | 1 | CO1 |
| 4 | Exploring the difference of needs of self and body | 1 | CO1 |
| 5 | Exploring sources of imagination in the self | 1 | CO1 |
| 6 | Exploring harmony of self with the body | 1 | CO2 |
| 7 | Exploring the feeling of trust | 1 | CO2 |
| 8 | Exploring the feeling of respect | 1 | CO2 |
| 9 | Exploring systems to fulfill human goal | 1 | CO2 |
| 10 | Exploring the four orders of nature | 1 | CO2 |
| 11 | Exploring coexistence in existence | 1 | CO3 |
| 12 | Exploring ethical human conduct | 1 | CO3 |
| 13 | Exploring humanistic models in education | 1 | CO3 |
| 14 | Exploring steps of transition towards universal human order | 1 | CO3 |
| | **Total Hours** | **14** | |

## Evaluation and Assessment Scheme:

**A. Internal Assessment Examination (IAE):**
Assessment consists of two class tests, each 10 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**
End Semester exam of 30 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA) :**
Continuous Assessment should consist of the following
**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)
**Attendance (Theory & Practical):** 05 marks
**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**
1. Assignment
2. Case Study
3. Debate

4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

**Reference Books:**

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

**Text Books:**

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2 nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 53-2

**Useful Links:**

https://www.youtube.com/watch?v=PXSEpPFCn38

| Course Title: Employability Enhancement Program -I (Communication) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: III | | | Term: ODD | | | Course Code: 24CSAEC301B | | | | | | |
| Teaching Scheme | | | | | | Evaluation Scheme | | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| -- | 1 | -- | -- | 1 | -- | 1 | -- | -- | -- | 25 | -- | 25 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment

## Course Objectives:

1. To train students on grooming and their all-round development.
2. To instill confidence amongst learners about interviewing influential personnel.

## Course Outcomes:

At the end of the course students will be able to:

1. Understand and demonstrate improved formal dressing and appearance.
2. Apply ideas, ask insightful questions and build connections through interview experiences.
3. Develop required vocabulary and updated knowledge of the current affairs at a global level.
4. Apply ethical behavioral skills at both academic as well as in professional life.

## List of Tutorials:

| Tut. No. | List of Tutorials | Hours | COs |
|---|---|---|---|
| | **Speaking Skills** | | |
| 1. | Role Play | 01 | CO1 |
| 2. | Poster Presentation (Group): Assignment 5 | 01 | CO1 |
| 3. | Interviewing an influential person with Geo tag photo or video: Assignment 8 | 01 | CO2 |
| 4. | Story Telling with moral/value | 01 | CO1 |
| 5. | Impromptu | 01 | CO3 |
| | **Reading Skills** | | |
| 6. | Summarization – unseen passage Assignment 2 | 01 | -- |
| 7. | Book Review Presentation: Assignment 4 | 01 | CO1 |
| 8. | Reading Newspaper Article | 01 | -- |

| Writing Skills | | | |
|---|---|---|---|
| 9. | Vocabulary Building: Crossword | 01 | CO3 |
| 10. | One Word Substitution, Collocation, Phrases & Idioms - Assignment 1 | 01 | CO3 |
| 11. | Expansion of an Idea- Assignment 3 | 01 | CO3 |
| 12. | Behavioral Ethics: Ethical Code of Conduct: Assignment 6 | 01 | CO4 |
| 13. | Dress & Appearance: Assignment 7 | 01 | CO1 |
| 14. | Paragraph Writing | 01 | -- |
| 15. | Dialogue Writing (Formal) | 01 | -- |
| | **Total** | **15** | |

## Examination Scheme:

**Continuous Assessment (CA)**: **25 Marks**

Assignment + Attendance = 05 + 05=10 Marks
Poster Presentation & interviewing an Influential person = 05 + 05 = 10 marks
Book Review & Role Play= 2.5 + 2.5 = 05 Marks

Assessment: There is internal assessment only

**Reference Books:**

1. M Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hill, 2008
2. Gadyalji Vaishali K, Communication Skills, Nandu Publications, 2010
3. Rai Urmila & Rai S.M, Business Communication, Himalaya Publishing House, 2007
4. Rai Urmila & Rai S.M, Business Communication, Himalaya Publishing House, 2008
5. Raman Meenakshi & Sharma Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2015
6. Raman Meenakshi & Singh Prakash, Business Communication, Oxford University Press, 2008
7. Locker O Kitty & Kaczmarek Kyo Stephen, Business Communication Building Critical Skills, McGraw Hill Education Private Limited, 2007
8. Chaturvedi P D & Chaturvedi Mukesh, Business Communication Concepts, Cases and Applications, Pearson Education, 2008
9. Luthans Fred, Organizational Behavior An Evidence-Based Approach, McGraw Hill Education Private Limited, 2013

**Text Books:**

1. M Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hill, 2008

**Useful Links:**

**Speaking Skills**

https://youtu.be/iNxl16ZkM-A?si=_smlyYEtxvHBD40S

https://youtu.be/EhgKvPWn9Vc?si=vboPgmmIyyVqsrcI

https://youtu.be/ftwVrEF_OlQ?si=sYiKRfg_xX1erVf6

https://youtu.be/TKfwenWIHhk?si=xn8GDiZIBYKB14M4

https://youtu.be/pbhK_OhMgA4?si=DeROjEtA6V__w5dL

https://youtu.be/a2dTNAryZ8g?si=6tA9U-ZAX4wQBi_x

https://youtu.be/QBnGmmBAgyc?si=JGm-TpmrslhE-ZB8

https://youtu.be/EhgKvPWn9Vc?si=vboPgmmIyyVqsrcI

https://youtu.be/z9F68dJSbOE?si=VVMrBOeNnc5XNln8

**Reading Skills**

https://youtu.be/KadZ3KYzM0I?si=XRmUOk2O8UmoMfEK

https://youtu.be/kCthrwUz68w?si=L4U4TJjuO72Us_dD

https://youtu.be/tpHp8oEHANQ?si=R-YOMfSa5LIuyXMR

**Writing Skills**

https://youtu.be/Zx-JcXsbUqQ?si=ysfXU8ZR4UM3U22P

https://youtu.be/5o_oph2vhGM?si=_4D6h8ZMiYSe0ZV4

# Bachelor of Engineering In Computer Engineering

## Third Year

Semester – V

SJCEM R – 24 ('C' SCHEME)

**Effective from Academic Year 2026-27**

## Program Structure for Third Year Computer Engineering

### Semester – V

### SCHEME: SJCEM R–24 Scheme C

| Course Code | Vertical | Course Name | Contact Hrs. | | | Credit Allotted | | | Total Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | Th | Tut | Pr | Th | Tut | Pr | |
| 24CSPCC501C | PCC | Theoretical Computer Science | 3 | 1 | - | 3 | 1 | - | 4 |
| 24CSPCC502C | PCC | Soft Computing | 2 | - | 2 | 2 | - | 1 | 3 |
| 24CSPEC501XC | PEC | Program Elective – I | 3 | - | 2 | 3 | - | 1 | 4 |
| 24CSPEC502XC | PEC | Program Elective – II | 2 | - | 2 | 2 | - | 1 | 3 |
| 24MDM501XC | MDM | Multidisciplinary Minor | 3 | - | 2 | 3 | - | 1 | 4 |
| 24OE501XC | OE | Open Elective I | 3 | - | - | 3 | - | - | 3 |
| 24CSVSE501C | VSEC | Employability Enhancement Program -IV (Web Technology Lab) | - | - | 2 | - | - | 1 | 1 |
| | | **Total** | **16** | **01** | **10** | **16** | **01** | **05** | **22** |

| Course Code | Vertical | Course Name | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| 24CSPCC501C | PCC | Theoretical Computer Science | 20 | 20 | 60 | 25 | - | 125 |
| 24CSPCC502C | PCC | Soft Computing | 20 | 20 | 60 | 25 | - | 125 |
| 24CSPEC501XC | PEC | Program Elective – I | 20 | 20 | 60 | - | 25 | 125 |
| 24CSPEC502XC | PEC | Program Elective – II | 20 | 20 | 60 | - | 25 | 125 |
| 24MDM501XC | MDM | Multidisciplinary Minor | 20 | 20 | 60 | 25 | - | 125 |
| 24OE501XC | OE | Open Elective I | 20 | 20 | 60 | - | - | 100 |
| 24CSVSE501C | VSEC | Employability Enhancement Program -IV (Technical) | - | - | - | 25 | - | 25 |
| | | **Total** | **120** | **120** | **360** | **100** | **50** | **750** |

**Program Electives Courses**

| Semester | Track 01 | Track 02 | Track 03 | Track 04 |
|---|---|---|---|---|
| | **Artificial Intelligence and Machine Learning** | **Data Science** | **Network Security** | **Image Processing** |
| **V** | Artificial Intelligence and Machine Learning | Applied Data Science | Cryptography and System Security | Image Processing |
| **VI** | Deep Learning | Data Mining and Business Intelligence | Information and Cyber Security | Computer Vision |
| **VII** | Natural Language Processing | Big Data Analytics | Digital Forensics | Virtual Reality |
| | Generative AI | Predictive Analytics | Block chain | Remote Sensing and GIS |

| Semester | Program Elective I | | | |
|---|---|---|---|---|
| | Track 01 | | Track 02 | |
| | Artificial Intelligence and Machine Learning | | Data Science | |
| **Sem V** | 24CSPEC5011C | Artificial Intelligence and Machine Learning | 24CSPEC5012C | Applied Data Science |

| Semester | Program Elective II | | | |
|---|---|---|---|---|
| | Track 03 | | Track 04 | |
| | Network Security | | Image Processing | |
| **Sem V** | 24CSPEC5021C | Cryptography and System Security | 24CSPCC5022C | Image Processing |

**Open Elective I Courses**

| Semester | Track 01 | | Track 02 | |
|---|---|---|---|---|
| | Entrepreneurship | | Research Methodology | |
| | **Code** | **Subject** | **Code** | **Subject** |
| **V** | 24OE5011C | Design Thinking | 24OE5012C | Research Methodology |

| Semester | Track 03 | | Track 04 | |
|---|---|---|---|---|
| | Foreign Language | | Business Management | |
| | **Code** | **Subject** | **Code** | **Subject** |
| **V** | 24OE5013C | Foreign Language I - German | 24OE5014C | Basics of Marketing Management |

| Course Title: Theoretical Computer Science | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: V | | | Term: ODD | | | | Course Code: 24CSPCC501C | | | | | |
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 3 | 1 | - | 3 | 1 | - | 4 | 20 | 20 | 60 | 25 | - | 125 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment

**Course Objectives:**

1 Acquire conceptual understanding of fundamentals of grammars and languages.
2 Build concepts of theoretical design of deterministic and non-deterministic finite automata and push down automata.
3 Develop understanding of different types of Turing machines and applications.
4 Understand the concept of undecidability.

**Course Outcomes:**

At the end of the course students will be able to:

1 Understand concepts of Theoretical Computer Science, difference and equivalence of DFA and NFA.
2 Understand the languages described by finite automata and regular expressions.
3 Design Context free grammar.
4 Design pushdown automata to recognize the language.
5 Develop an understanding of computation through Turing Machine.
6 Acquire fundamental understanding of decidability and undecidability.

| Module | Contents | Hours | Cos |
|---|---|---|---|
| I | **Basic Concepts and Finite Automata** | 09 | CO1 |
| | • Introduction of TCS, Alphabets, Strings, Languages Closure properties, Finite Automata (FA) and Finite State machine (FSM).<br>• Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA): Definitions, transition diagrams and Language recognizers, Equivalence between NFA with and without ε- transitions, NFA to DFA Conversion, Minimizationof DFA, FSM with output: Moore and Mealy machines.<br><br>**Self-Learning Topics:** Practice exercise on FA and NFA | | |
| II | **Regular Expressions and Languages** | 08 | CO2 |
| | • Equivalence of RE and FA, Arden's Theorem, RE Applications<br>• Closure properties of RLs, Decision properties of RLs, Pumping lemma for RLs.<br><br>**Self-Learning Topics:** Practice exercise on Regular Expressions, Identify the tools | | |
| III | **Grammars** | 09 | CO3 |
| | • Grammars and Chomsky hierarchy<br>• Regular Grammar (RG), Equivalence of Left and Right linear grammar, Equivalence of RG and FA.<br>• **Context Free Grammars (CFG)**<br>Definition, Sentential forms, Leftmost and Rightmost derivations, Parse tree, Ambiguity, Simplification and Applications, Normal Forms: Chomsky Normal Forms (CNF) and Greibach Normal Forms (GNF), Context Freelanguage (CFL) - Pumping lemma, Closure properties.<br><br>**Self-Learning Topics:** Practice Numericals on CFG | | |
| IV | **Pushdown Automata(PDA)** | 05 | CO4 |
| | Language of PDA, PDA as generator, decider and acceptor of CFG, Deterministic PDA, Non-Deterministic PDA.<br><br>**Self-Learning Topics:** List the examples of PDA | | |
| V | **Turing Machine (TM)** | 09 | CO5 |
| | Definition, Design of TM as generator, decider and acceptor, Variants of TM: Multitrack, Multitape, Universal TM,Applications.<br><br>**Self-Learning Topics:** Practice Numericals on TM | | |

| | | | |
|---|---|---|---|
| VI | **Undecidability** | 05 | CO6 |
| | Recursive and RecursivelyEnumerable Languages, Halting Problem, Rice's Theorem, Post Correspondence Problem.<br><br>**Self-Learning Topics:** Explore other examples of undecidable problems across different areas of computer science | | |
| | **Total** | **45** | |

## Evaluation and Assessment Scheme:

**A. Internal Assessment Examination (IAE):**
Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**
End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**

Continuous Assessment should consist of the following
Experiments / Tutorials (8 to 10): 10 marks (All COs / LOs should be covered)
Attendance (Theory & Practical): 05 marks
Teacher Assessment Examination (TAE): 10 Marks
List of Teacher Assessment Examination (TAE):
1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

**Reference Books:**

1. J. C. Martin, *"Introduction to Languages and the Theory of Computation"*, 4th Edition,Tata McGraw Hill Publication, 2013.
2. Kavi Mahesh, *"Theory of Computation: A Problem Solving Approach"*, KindleEdition, Wiley-In- dia, 2011.

**Text Books:**

1. John E. Hopcroft, Rajeev Motwani, Jeffery D. Ullman, ***"Introduction to AutomataTheory, Lan- guages and Computation"***, 3rd Edition, Pearson Education, 2008.
2. A Michael Sipser, **"Theory of Computation"**, 3rd Edition, Cengage learning. 2013.
3. Vivek Kulkarni, ***"Theory of Computation",*** Illustrated Edition, Oxford UniversityPress, (12 April 2013) India.

**Useful Links**

1. www.jflap.org
2. https://nptel.ac.in/courses/106/104/106104028/
3. https://nptel.ac.in/courses/106/104/106104148/

# Course Title: Soft Computing

| Semester: V | | | Term: ODD | | | | Course Code: 25CSPCC502C | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 2 | - | 2 | 2 | - | 1 | 3 | 20 | 20 | 60 | 25 | - | 125 |

**Sustainable Development Goals Mapped:**
SDG 4: Quality Education
SDG 8: Industry Innovation
SDG 9: Economic Growth

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

**Course Objectives:**

1. To understand fundamentals of soft computing techniques
2. To apply fuzzy logic and neural networks for problem solving
3. To explore evolutionary algorithms and optimization techniques
4. To analyze hybrid intelligent systems
5. To introduce recent advancements in soft computing

**Course Outcomes:**

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

1. Explain soft computing concepts and techniques.
2. Apply fuzzy logic for decision-making problems.
3. Design artificial neural network models.
4. Apply genetic algorithms for optimization.
5. Analyze hybrid soft computing systems.
6. Explore advanced soft computing techniques.

| Module | Contents | Hours | COs |
|---|---|---|---|
| 1 | **Module 1: Introduction to Soft Computing** | 5 | CO1 |
| | Hard vs Soft Computing, Characteristics of Soft Computing, Components: Fuzzy Logic, ANN, Evolutionary Computing, Applications of Soft Computing.<br>**Self-Learning Topics:** History and evolution of soft computing, Real-world applications (healthcare, robotics, finance), Comparison with traditional AI. | | |
| 2 | **Module 2: Fuzzy Logic Systems** | 5 | CO2 |
| | Fuzzy sets and membership functions, Fuzzy operations and relations Fuzzy inference systems (Mamdani, Sugeno), Defuzzification methods.<br>**Self-Learning Topics:** Design of fuzzy controllers, Type-2 fuzzy systems, Fuzzy logic in industrial automation | | |
| 3 | **Module 3: Artificial Neural Networks** | 6 | CO3 |
| | Biological neuron vs artificial neuron, Perceptron, multilayer perceptron, Learning rules (Hebbian, Backpropagation), Activation functions.<br>**Self-Learning Topics:** Deep neural networks overview, CNN basics, Optimization techniques (Gradient Descent variants) | | |
| 4 | **Module 4: Evolutionary Algorithms** | 5 | CO4 |
| | Genetic Algorithms: encoding, selection, crossover, mutation Fitness function, Applications in optimization.<br>**Self-Learning Topics:** Differential Evolution, Particle Swarm Optimization (PSO)<br>Multi-objective optimization | | |
| 5 | **Module 5: Hybrid Soft Computing Systems** | 4 | CO5 |
| | Neuro-fuzzy systems, Genetic-fuzzy systems, Hybrid intelligent systems.<br>**Self-Learning Topics:** Adaptive Neuro-Fuzzy Inference System (ANFIS), Hybrid models in real-world applications. | | |
| 6 | **Module 6: Advanced Soft Computing Techniques** | 5 | CO6 |
| | Introduction to Swarm Intelligence, Basics of Deep Learning<br>Soft Computing in Big Data and IoT, Introduction to Explainable AI (XAI).<br>**Self-Learning Topics:** Reinforcement Learning basics,AI optimization in real-world systems, Ethical issues in intelligent systems | | |
| | **Total** | 30 | |

**List of Experiments:**

| Sr. No. | Title of Experiment | COs Mapped |
|---|---|---|
| 1 | Case study on real world applications of Soft Computing | CO1 |
| 2 | Implementation of fuzzy set operations | CO2 |
| 3 | Implementation of membership functions | CO2 |
| 4 | Develop a Fuzzy Inference System for a washing machine controller. | CO2 |
| 5 | Implement a Perceptron Network for binary classification using logic gates. | CO3 |
| 6 | Train a Multi-Layer Perceptron (MLP) using backpropagation for digit recognition. | CO3 |
| 7 | Implement a Genetic Algorithm for TSP or function optimization. | CO4 |
| 8 | Compare performance of different GA operators on benchmark functions | CO4 |
| 9 | Create a Neuro-Fuzzy System (ANFIS) for classification or regression. | CO5 |
| 10 | Use Particle Swarm Optimization (PSO) for nonlinear function minimization. | CO6 |
| 11 | Case study on hybrid system | CO6 |
| 12 | Mini Project using hybrid soft computing techniques for real-world problem solving. | CO6 |

**Evaluation Scheme and Assessment:**

**A. Internal Assessment Examination:**
Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination:**
End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**
Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**
1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit

6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any Other

**Note:** Number of activities to be conducted under TAE would be as per the subject need.

**Reference Books:**

1. S. Rajasekaran – *Neural Networks, Fuzzy Logic and Genetic Algorithms*
2. J.S.R. Jang – *Neuro-Fuzzy Systems*
3. Simon Haykin – *Neural Networks and Learning Machines*
4. David Goldberg – *Genetic Algorithms*
5. Xin-She Yang – *Nature-Inspired Optimization Algorithms*
6. Goodfellow – *Deep Learning*

**Text Books:**

1. Timothy Ross – *Fuzzy Logic with Engineering Applications*
2. Laurene Fausett – *Fundamentals of Neural Networks*
3. Mitchell Melanie – *Introduction to Genetic Algorithms*
4. Haykin – *Neural Networks*

**Useful Links:**

1. NPTEL – Soft Computing
2. NPTEL – Neural Networks and Deep Learning
3. Coursera – Machine Learning (Andrew Ng)
4. Coursera – Deep Learning Specialization

| Course Title: Artificial Intelligence and Machine Learning | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: V | | | Term: ODD | | | | Course Code: 24CSPEC5011C | | | | | |
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 3 | - | 2 | 3 | - | 1 | 4 | 20 | 20 | 60 | - | 25 | 125 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment,

**Course Objectives:**

After completion of the course, learner will be able to:

1. Understand the foundational concepts of Artificial Intelligence and Machine Learning.
2. Develop intelligent agents that simulate reasoning and decision-making.
3. Apply search strategies, logic, and knowledge representation in AI-based solutions.
4. Introduce and implement core ML algorithms for classification, regression, and clustering.
5. Provide hands-on experience in solving real-world problems using AI and ML tools.

**Course Outcomes:**

At the end of the course students will be able to:

1. Understand the foundational concepts of Artificial Intelligence and Machine Learning.
2. Develop intelligent agents that simulate reasoning and decision-making.
3. Apply search strategies, logic, and knowledge representation in AI-based solutions.
4. Introduce and implement core ML algorithms for classification, regression, and clustering.
5. Provide hands-on experience in solving real-world problems using AI and ML tools.

| Module | Contents | Hours | COs |
|---|---|---|---|
| I | **Foundations of Artificial Intelligence** | 07 | CO1 |
| | Introduction to AI and its applications<br>Intelligent agents and environments<br>PEAS representation<br>Problem-solving as search<br>Uninformed Search: BFS, DFS<br>Informed Search: Best-First Search, A* Algorithm<br><br>**Self-learning Topics:** Real-world Applications of Search Algorithms in Robotics and Navigation | | |
| II | **Knowledge Representation and Reasoning** | 08 | CO2 |
| | Propositional and Predicate Logic<br>First-order logic syntax and semantics<br>Inference rules: Modus Ponens, Resolution<br>Rule-based systems<br>Semantic networks, frames<br>Forward and backward chaining<br><br>**Self-learning Topics:** Ontologies and Description Logics in Semantic Web and Knowledge Graphs | | |
| III | **Planning and Decision Making** | 07 | CO3 |
| | Planning problem formulation<br>State-space representation<br>Partial order planning<br>Utility theory and decision networks<br>Basics of game playing (Minimax, Alpha-Beta pruning)<br><br>**Self-learning Topics:** Markov Decision Processes (MDP) – Basics and Applications in AI | | |
| IV | **Introduction to Machine Learning** | 07 | CO4 |
| | ML overview and applications<br>Types of learning: Supervised, Unsupervised, Reinforcement<br>Steps in ML pipeline<br>Feature selection and scaling<br>Bias-variance trade-off<br><br>**Self-learning Topics:** Use of Python Libraries (e.g., Scikit-learn) for Data Preprocessing and Visualization | | |
| V | **Supervised and Unsupervised Learning Algorithms** | 09 | CO5 |
| | Supervised Learning: Linear and Logistic Regression, Decision Trees, Random Forest, k-Nearest Neighbors (k-NN)<br>Unsupervised Learning: Clustering: k-Means, Hierarchical<br>Dimensionality Reduction: PCA | | |

| | | | |
|---|---|---|---|
| | **Self-learning Topics:** Evaluation Metrics for Classification and Clustering | | |
| **VI** | **Neural Networks and Deep Learning** | 07 | CO6 |
| | Biological vs artificial neuron<br>Perceptron and Multi-layer Perceptron<br>Activation functions<br>Backpropagation<br>Introduction to Deep Learning frameworks: TensorFlow, Keras<br>Applications of CNNs and RNNs (overview only)<br><br>**Self-learning Topics:** Transfer Learning – Concept and Use in Image Classification with Pre-trained Models | | |
| | **Total** | **45** | |

## List of Experiments:

| Sr. No. | Name of Experiment | COs |
|---|---|---|
| **1** | Implement BFS and DFS for a path-finding problem. | CO1 |
| **2** | Solve a problem using A* search algorithm. | CO1 |
| **3** | Develop a rule-based expert system (e.g., for medical diagnosis). | CO2 |
| **4** | Apply propositional logic and implement forward chaining. | CO2 |
| **5** | Solve a game using Minimax and Alpha-Beta pruning. | CO2 |
| **6** | Build a Linear Regression model using scikit-learn. | CO3 |
| **7** | Implement a Logistic Regression classifier for binary classification. | CO3 |
| **8** | Create and visualize a Decision Tree classifier. | CO4 |
| **9** | Apply k-Means clustering to unlabeled data and visualize clusters. | CO4 |
| **10** | Perform PCA on a dataset and explain the variance retained. | CO5 |
| **11** | Train a basic MLP using TensorFlow/Keras for digit classification. | CO5, CO6 |
| **12** | Compare the performance of various classifiers using cross-validation. | CO6 |

## Evaluation and Assessment Scheme:

**A. Internal Assessment Examination (IAE):**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

**D. Oral & Practical Exam:**

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Tom Mitchell, Machine Learning, McGraw-Hill.
2. Ian Goodfellow et al., Deep Learning, MIT Press.
3. Elaine Rich & Kevin Knight, Artificial Intelligence, McGraw-Hill.
4. Ethem Alpaydin, Introduction to Machine Learning, MIT Press.

**Text Books:**

1. Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Ed., Pearson.
2. Aurélien Géron, Hands-On ML with Scikit-Learn, Keras, and TensorFlow, O'Reilly.

**Useful Links**

1 https://onlinecourses.nptel.ac.in/noc22_cs54/preview
2 https://www.coursera.org/learn/neural-networks-deep-learning

| Course Title: Applied Data Science | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester: V** | | | **Term: ODD** | | | | **Course Code: 24CSPEC5012C** | | | | | |
| **Teaching Scheme** | | | | | | | **Evaluation Scheme** | | | | | |
| **Contact Hrs.** | | | **Credit Allotted** | | | **Total Credit** | **IAE 1** | **IAE 2** | **ESE** | **CA** | **OR/PR** | **Total** |
| **Th** | **Tu** | **Pr** | **Th** | **Tu** | **Pr** | | | | | | | |
| 3 | - | 2 | 3 | - | 1 | 4 | 20 | 20 | 60 | 25 | 25 | 150 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment,

**Course Objectives:**

At the end of the course students will be able to:

1. Introduce students to the basic concepts of data science.
2. Acquire an in-depth understanding of data exploration and data visualization.
3. Familiar with various anomaly detection techniques.
4. Understand the data science techniques for different applications.

**Course Outcomes:**

At the end of the course students will be able to:

1. Gain fundamental knowledge of the data science process.
2. Apply data exploration and visualization techniques.
3. Apply anomaly detection techniques.
4. Gain an in-depth understanding of time-series forecasting.
5. Apply different methodologies and evaluation strategies.
6. Apply data science techniques to real world applications.

| Module | Contents | Hours | COs |
|---|---|---|---|
| I | **Introduction to Data Science** | 4 | CO1 |
| | Introduction to Data Science, Data Science Process<br>**Motivation to use Data Science Techniques:** Volume, Dimensions and Complexity, Data Science Tasks and Examples.<br>Overview of Data Preparation, Modeling, Difference between data science and data analytics<br><br>**Self-Learning Topics:** Applications of Data Science | | |
| II | **Data Exploration** | 8 | CO2 |
| | Types of data, Properties of data<br>**Descriptive Statistics:**<br>**Univariate Exploration:** Measure of Central Tendency, Measure of Spread, Symmetry.<br>**Skewness:** Karl Pearson Coefficient of skewness, Bowley's Coefficient, Kurtosis Multivariate<br>**Exploration:** Central Data Point, Correlation, Different forms of correlation, Karl Pearson Correlation Coefficient for bivariate distribution<br>**Inferential Statistics:** Overview of Various forms of distributions: Normal, Poisson, Test Hypothesis, Central limit theorem, Confidence Interval, Z-test, t-test, Type-I, Type-II Errors, ANOVA<br><br>**Self-Learning Topics:** Two Way ANOVA | | |
| III | **Methodology and Data Visualization** | 8 | CO3 |
| | **Methodology:** Overview of model building, Cross Validation, K-fold cross validation, leave-1 out, Bootstrapping<br>**Data Visualization:**<br>Univariate Visualization: Histogram, Quartile, Distribution Chart Multivariate Visualization: Scatter Plot, Scatter Matrix, Bubble chart, Density Chart Roadmap for Data Exploration<br><br>**Self-Learning Topics:** Visualizing high dimensional data: Parallel chart, Deviation chart, Andrews Curves. | | |
| IV | **Anomaly Detection** | 8 | CO4 |
| | Outliers, Causes of Outliers, Anomaly detection techniques, Outlier Detection using Statistics Outlier Detection using Distance based method, Outlier detection using density-based methods, SMOTE<br><br>**Self-Learning Topics**: SMOTE dataset balancing Applications | | |
| V | **Time Series Forecasting** | 8 | CO5 |
| | Taxonomy of Time Series Forecasting methods, Time Series Decomposition | | |

| | | | |
|---|---|---|---|
| | **Smoothening Methods:** Average method, Moving Average smoothing, Time series analysis using linear regression, ARIMA Model, **Performance Evaluation:** Mean Absolute Error, Root Mean Square Error, Mean Absolute Percentage Error, Mean Absolute Scaled Error<br><br>**Self-Learning Topics:** Real-world Applications of ARIMA Model | | |
| **VI** | **Applications of Data Science** | 9 | CO6 |
| | **Predictive Modeling:** House price prediction, Fraud Detection **Clustering:** Customer Segmentation<br>**Time series forecasting:** Weather Forecasting<br>**Recommendation engines:** Product recommendation<br><br>**Self-Learning Topics:** Case Study on Product Recommendation systems | | |
| | **Total** | **45** | |

## List of Experiments:

| Exp. No | Name of Experiment | COs |
|---|---|---|
| 1 | Explore the descriptive and inferential statistics on the given dataset. | CO1,CO2 |
| 2 | Apply data cleaning techniques (e.g. Data Imputation). | CO1,CO2 |
| 3 | Explore data visualization techniques. | CO3 |
| 4 | Implement and explore performance evaluation metrics for Data Models (Supervised/Unsupervised Learning) | CO2,CO4 |
| 5 | Use SMOTE technique to generate synthetic data.(to solve the problem of class imbalance) | CO4 |
| 6 | Outlier detection using distance based/density based method. | CO4 |
| 7 | Implement time series forecasting. | CO5 |
| 8 | Illustrate data science lifecycle for selected case study. (Prepare case study document for the selected case study)<br>Suggested Case Studies:<br>1. Customer Segmentation<br>2. Fraud Detection<br>3. House Price prediction<br>4. Product Recommendation<br>5. Stock price prediction<br>6. Weather prediction | CO1,CO2,CO3,CO4, CO5,CO6 |

## Evaluation and Assessment Scheme:

### A. Internal Assessment Examination (IAE):

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

### B. End Semester Theory Examination (ESE):

End Semester exam of 60 Marks will be conducted based on entire syllabus.

### C. Continuous Assessment (CA) :

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

### D. Oral & Practical Exam:

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Jake VanderPlas. —Python Data Science Handbook‖, O'reilly Publications.
2. Francesco Ricci, LiorRokach, BrachaShapira, Paul B. Kantor, —Recommender Systems Handbook‖, Springer.
3. C. Gupta, V. K. Kapoor —Fundamentals of Mathematical Statistics‖, S. Chand and Sons, New Delhi.
4. B. L. Agrawal. —Basic Statistics‖, New Age Publications, Delhi.

**Text Books:**

1. Vijay Kotu, Bala Deshpande. —Data Science Concepts and Practice‖, Elsevier, M.K. Publishers.
2. Steven Skiena, —Data Science Design Manual‖, Springer International Publishing AG
3. Samir Madhavan. —Mastering Python for Data Science‖, PACKT Publishing

4. Dr. P. N. Arora, Sumeet Arora, S. Arora, Ameet Arora, ―Comprehensive Statistical Methods‖, S.Chand Publications, New Delhi.

**Useful Links:**

1. https://onlinecourses.nptel.ac.in/noc22_cs32/preview
2. https://onlinecourses.nptel.ac.in/noc21_cs69/preview

# Course Title: Cryptography and System Security

| Semester: V | Term: ODD | Course Code: 24CSPEC5021C |
|---|---|---|

| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 02 | - | 02 | 02 | - | 01 | 03 | 20 | 20 | 60 | - | 25 | 125 |

Sustainable Development Goals Mapped:
SDG 9: Industry, Innovation and Infrastructure
SDG 16: Peace, Justice and Strong Institutions
SDG 4: Quality Education

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment,

**Course Objectives:**

1. To introduce the fundamental concepts and mathematical foundations of cryptography.
2. To study classical and modern encryption techniques for secure communication.
3. To analyze symmetric and asymmetric cryptographic algorithms and their working principles.
4. To explore hash functions, message authentication, and digital signature mechanisms.

**Course Outcomes:**

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

1. Explain basic cryptographic concepts and number theory principles.
2. Apply classical encryption and decryption techniques.
3. Apply public key cryptography algorithms for secure key exchange
4. Analyze symmetric key algorithms and block cipher operations.
5. Evaluate hash functions and message authentication techniques
6. Analyze digital signature schemes and key management concepts

| Module | Contents | Hours | COs | RBT Level |
|---|---|---|---|---|
| **I** | **Introduction to Cryptography** | **04** | **CO1** | **2** |
| | Introduction to Cryptography, Types of cryptographic systems, Mathematical Foundations: Modular arithmetic, Euclidean Algorithm, Extended Euclidean Algorithm (for multiplicative inverse), Fermat's Little Theorem, Euler's Totient Function, Euler's Theorem<br>**Self-Learning Topics:** Fast modular exponentiation | | | |
| **II** | **Classical Encryption Techniques** | **05** | **CO2** | **3** |
| | Substitution Techniques: Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Vigenère Cipher. Transposition Techniques: Rail Fence Cipher, Simple Columnar Transposition, Keyed Columnar Transposition, Cryptanalysis: Brute force attack, Frequency analysis<br>**Self-Learning Topics:** Hill Cipher | | | |
| **III** | **Symmetric Key Cryptography** | **06** | **CO3** | **3** |
| | Symmetric Cipher Model: Structure of symmetric encryption, Confusion and diffusion principles, Block Cipher Fundamentals: Block vs Stream cipher, Feistel structure, Substitution-Permutation Network (SPN). Data Encryption Standard (DES), Advanced Encryption Standard (AES), Block Cipher Modes of Operation: ECB, CBC, CFB, OFB, CTR (intro)<br>**Self-Learning Topics:** Lightweight cryptography | | | |
| **IV** | **Public Key Cryptography** | **05** | **CO4** | **4** |
| | Principles of Public Key Cryptography: Need for asymmetric cryptography, Key pair concept (public/private key), Applications. RSA Algorithm: Key generation, Encryption, Decryption, Mathematical basis (modular exponentiation). Diffie-Hellman Key Exchange: Concept of shared secret, Discrete logarithm problem.<br>**Self-Learning Topics:** Elliptic Curve Cryptography (ECC) | | | |
| **V** | **Cryptographic Hash Functions** | **05** | **CO5** | **5** |
| | Hash Functions Overview: Definition and purpose, Properties of hash functions. Secure Hash Algorithms: MD5, SHA-1, SHA-256. Message Authentication: Message Authentication Code (MAC), HMAC (working principle)<br>**Self-Learning Topics:** SHA-3 and Keccak Algorithm overview | | | |
| **VI** | **Digital Signatures & Key Management** | **05** | **CO6** | **4** |
| | Digital Signatures: Concept and requirements, Process of signing and verification, Properties. RSA Digital Signature: Signature generation, Verification. Digital Signature Standards: DSS concept, Introduction to DSA. Key Management: Key generation, Key distribution challenges, Key lifecycle. Digital Certificates<br>Syllabus Contents<br>**Self-Learning Topics:** Structure of X.509 | | | |
| | **Total** | **30** | | |

**List of Experiments:**

| Sr. No. | Title of Experiment | COs Mapped |
|---|---|---|
| 1 | Implementation of **Euclidean and Extended Euclidean Algorithm** to compute GCD and modular inverse | **CO1** |
| 2 | Implementation **of Caesar Cipher and Monoalphabetic Cipher** | **CO2** |
| 3 | Implementation of **Playfair Cipher / Vigenère Cipher** | **CO2** |
| 4 | Implementation of **Data Encryption Standard (DES)** (basic round operations or library-based) | **CO3** |
| 5 | Implementation of **RSA Algorithm (key generation, encryption, decryption)** | **CO4** |
| 6 | Implementation of **Diffie-Hellman Key Exchange Algorithm** | **CO4** |
| 7 | Implementation of **hash generation using SHA-1 / SHA-256** | **CO5** |
| 8 | Implementation of **Message Authentication Code (MAC / HMAC)** | **CO5** |
| 9 | Implementation of **Digital Signature using RSA** (sign and verify message) | **CO6** |
| 10 | Implementation of **secure file/message transfer using encryption + hash + signature.** | **CO6** |

**Evaluation Scheme and Assessment:**

**A. Internal Assessment Examination:**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination:**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any Other

**Note:** Number of activities to be conducted under TAE would be as per the subject need.

**D. Oral & Practical Exam:**

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Applied Cryptography: Protocols, Algorithms and Source Code in C, Bruce Schneier, John Wiley & Sons, 2nd Edition
2. Introduction to Modern Cryptography, Jonathan Katz, Yehuda Lindell, Chapman & Hall/CRC, 3rd Edition
3. Cryptography Engineering: Design Principles and Practical Applications, Niels Ferguson, Bruce Schneier, Tadayoshi Kohno, Wiley Publications, 1st Edition
4. Understanding Cryptography: A Textbook for Students and Practitioners, Christof Paar, Jan Pelzl, Springer, 1st Edition

**Text Books:**

1. Cryptography and Network Security: Principles and Practice: William Stallings, Pearson Education, 8th Edition
2. Cryptography and Network Security, Behrouz A. Forouzan, McGraw-Hill Education, 3rd Edition
3. Cryptography and Network Security, Atul Kahate, Tata McGraw-Hill, 3rd Edition

**Useful Links:**

1. Coursera – Cryptography I (Stanford University): https://www.coursera.org/learn/crypto
2. NPTEL – Cryptography and Network Security: https://onlinecourses.nptel.ac.in/noc22_cs90/preview
3. NPTEL – Foundations of Cryptography: https://nptel.ac.in/courses/106106221
4. Coursera – Introduction to Cryptography: https://www.coursera.org/learn/an-introduction-to-cryptography

# Course Title: Image Processing

| Semester: V | Term: ODD | Course Code: 24CSPEC5022C |
|---|---|---|

| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 2 | - | 2 | 2 | - | 1 | 3 | 20 | 20 | 60 | - | 25 | 125 |

**Sustainable Development Goals Mapped:**
SDG 16 – Peace, Justice and Strong Institutions
SDG 9 – Industry, Innovation and Infrastructure
SDG 4 – Quality Education
SDG 8 – Decent Work and Economic Growth
SDG 11 – Sustainable Cities and Communities

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

**Course Objectives:**

1. To understand fundamental concepts and terminologies of digital image processing.
2. To explore various transformation techniques for effective image representation.
3. To apply image enhancement techniques in both spatial and frequency domains.
4. To comprehend and implement image segmentation and region-based analysis.
5. To study morphological operations and their applications in image analysis.
6. To learn different image compression techniques and standards for efficient storage and transmission.

**Course Outcomes:**

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

1 .Describe fundamental concepts and steps of digital image processing..
2 .Apply transformation and enhancement techniques to digital images..
3 .Analyze and compare segmentation techniques for various applications..
4 .Evaluate morphological operations and assess their impact on images..
5 .Design efficient workflows using compression algorithms..
6 .Justify the use of specific image processing techniques in practical systems.

| Module | Contents | Hours | COs |
|---|---|---|---|
| I | **Digital Image Fundamentals** | 3 | CO1 |
| | Introduction and applications of digital image processing, Fundamental steps and components of an image processing system, Image Acquisition, Sampling & Quantization, Basic operations on images.<br><br>**Self-Learning Topics:** A simple image model, Sampling and quantization, | | |
| II | **Image Transforms** | 6 | CO2 |
| | 2D systems and necessary mathematical preliminaries, 2D orthogonal and unitary transforms, Discrete Fourier Transform (DFT), Karhunen-Loeve (KL) Transform, Hadamard Transform<br><br>**Self-Learning Topics:** Applications of Fourier Transform in Image Filtering and Frequency Analysis | | |
| III | **Image Enhancement** | 4 | CO3 |
| | Point processing techniques, Basic gray level transformations, Convolution and correlation, Spatial domain techniques : Contrast stretching & Histogram processing, Filtering: Smoothing filters & Sharpening filters<br><br>**Self-Learning Topics:** Adaptive Histogram Equalization (CLAHE) and Its Role in Medical Imaging | | |
| IV | **Image Segmentation and Analysis** | 6 | CO4 |
| | Edge detection (Sobel, Prewitt, etc.) , Thresholding techniques, Image representation (region & boundary) ,ML overview and applications Types of learning: Supervised, Unsupervised, Reinforcement ,Steps in ML pipeline<br><br>**Self-Learning Topics:** Use of Machine Learning Models for Automated Image Classification | | |
| V | **Morphological Image Processing** | 5 | CO5 |
| | Introduction to Morphological Processing, Basic Morphological Operations: Dilation, Erosion, Opening, Closing, Supervised Learning: Linear and Logistic Regression, Decision Trees, Random Forest, k-Nearest Neighbors (k-NN).<br><br>**Self-Learning Topics:** Unsupervised Learning: Clustering: k-Means, Hierarchical Dimensionality Reduction: PCA | | |
| VI | **Image Compression** | 6 | CO6 |
| | Fundamentals of compression, Compression m,odels, Need for compression Lossless vs. lossy Compression, Huffman coding, Basics of information theory, Run-length coding, DCT-based compression (JPEG | | |

| Module | Contents | Hours | COs |
|---|---|---|---|
| | concept).<br><br>**Self-Learning Topics:** Huffman coding, Dictionary-based compression, Image compression Standards | | |
| | **Total** | **30** | |

**List of Experiments:**

| Sr. No. | Title of Experiment | COs Mapped |
|---|---|---|
| 1 | Read and display grayscale and RGB images. Perform basic image operations. | CO1 |
| 2 | Apply Discrete Fourier Transform (DFT) and inverse DFT on an image. | CO2 |
| 3 | Perform image sampling and quantization. | CO1 |
| 4 | Apply spatial filters: Smoothing (mean, Gaussian) and Sharpening (Laplacian). | CO2 |
| 5 | Implement edge detection using Sobel, Prewitt, LoG, and Canny operators. | CO3 |
| 6 | Perform region-based segmentation using region growing. | CO3 |
| 7 | Apply morphological operations: erosion, dilation, opening, and closing. | CO4 |
| 8 | Perform Run-Length and Huffman Encoding for image compression. | CO5 |
| 9 | Compare lossless and lossy compression on a sample image. | CO5,6 |
| 10 | Mini-project: Apply a complete pipeline (enhancement, segmentation, compression) | CO6 |

**Evaluation and Assessment Scheme:**

**A. Internal Assessment Examination (IAE):**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment(CA): 25 Marks**

1. Term work should consist of 8 - 10 experiments / tutorials (whichever is applicable)
2. Journal must include at least 06 assignments.
3. The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing marks in term work.

Total 25 Marks: (Minimum passing marks is 40%)

**Experiments:** 10 marks
**Attendance (Theory & Practical):** 05 marks
**Assignments:** 10 Marks

**D. Oral & Practical Exam**

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Milan Sonka, Vaclav Hlavac, Boyle, Digital Image Processing and Computer Vision, Cengage Learning.
2. S. Jayaraman, S. Esakkirajan, T. Veerkumar, Digital Image Processing, Tata McGraw-Hill.
3. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, 2nd Ed.

**Text Books:**

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, 4th Edition, PHI, 2018.
2. Bernd Jähne, Digital Image Processing, 6th Edition, Springer, 2005.
3. A. K. Jain, Fundamentals of Digital Image Processing, PHI.

**Useful Links**

1. NPTEL - Digital Image Processing by Prof. P. K. Biswas (IIT Kharagpur)
   https://nptel.ac.in/courses/117105079
2. NPTEL - Digital Image Processing by Prof. A. N. Rajagopalan (IIT Madras)
   https://nptel.ac.in/courses/106106090

| Course Title: Design Thinking | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: V | | | Term: ODD | | | | Course Code: 24OE5011C | | | | | |
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 3 | - | - | 3 | - | - | 3 | 20 | 20 | 60 | - | - | 100 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment,

**Course Objectives:**

At the end of the course students will be able to:

1. Introduce a learner to the principles of Design Thinking
2. Familiarize a learner with the process (stages) of Design Thinking
3. Expose a learner to various case studies of Design Thinking

**Course Outcomes:**

At the end of the course students will be able to:

1. Compare traditional approach to problem solving with the Design Thinking approach and discuss the principles along with the process of Design Thinking
2. Define a user persona using Empathy Mapping
3. Frame a problem statement using various Design Thinking tools
4. Select best idea among the ideas generated through various Design Thinking tools
5. Create prototypes using engineering principles
6. Test the prototypes and gather feedback for refining the prototype

| Module | Contents | Hours | COs |
|---|---|---|---|
| I | **Introduction to Design Thinking** | 6 | CO1 |
| | Definition, comparison of traditional approach with Design Thinking, process (stages) of Design Thinking, case studies | | |
| II | **Creating User Persona** | 8 | CO2 |
| | Interview technique, user observation technique, creation of empathy map | | |
| III | **Defining problem statement** | 8 | CO3 |
| | Cause and effect, mind mapping and journey maps technique | | |
| IV | **Ideation** | 8 | CO4 |
| | Brain storming, Bench marking and prioritizing technique | | |
| V | **Prototype generation** | 8 | CO5 |
| | Rules of prototype generation, Low and high-fidelity prototypes, Prototyping techniques - Paper, Digital and 3D prototyping | | |
| VI | **Testing the prototype** | 7 | CO6 |
| | Evaluation techniques: Interviews, User observation, Wire framing, A/B Testing | | |
| | **Total** | **45** | |

| Sr. No. | Suggested Activities List | COs |
|---|---|---|
| 1. | Conducting user interviews and observations for a specific product or system to identify user pain points. Prepare an empathy map. | CO1 |
| 2. | Developing detailed user personas based on their empathy research. | CO2 |
| 3. | Synthesizing the findings from user research to define a clear problem statement in engineering terms. | CO3 |
| 4. | Performing a brainstorming session within the group using mind mapping techniques to generate creative solutions to the defined problem. | CO4 |
| 5. | Creating a prototype for selected idea using engineering principles. Prototype could be a physical model, electronic circuits, web or mobile app or a combination of these. | CO5 |
| 6. | Testing the prototype with the users and gathering feedback to created refined prototype. | CO6 |

## Evaluation Scheme and Assessment:

**A. Internal Assessment Examination:**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination:**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**Reference Books:**

1. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School, Idris Mootee, Wiley, 2013
2. Change by Design, Tim Brown, Harper Business, 2009

**Text Books:**

1. Design Thinking: Methodology Book, Emrah Yayichi, 2016
2. Handbook of Design Thinking: Christian Mueller-Roterberg, 2018

**Useful Links:**

1. Empathy map
   https://www.nngroup.com/articles/empathy-mapping/

2. Prototyping
   https://staragile.com/blog/prototype-in-design-thinking

3. Design Thinking case studies
   https://voltagecontrol.com/blog/8-great-design-thinking-examples/
   https://dyworks.in/design-thinking-case-studies/

| Course Title: Research Methodology | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: V | | | Term: ODD | | | | Course Code: 24OE5012C | | | | | |
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 3 | - | - | 3 | - | - | 3 | 20 | 20 | 60 | - | - | 100 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment

## Course Objectives:

At the end of the course students will be able to:

1. Understand the fundamental concepts of research including constructs, hypotheses, propositions,
2. Differentiate among various types of research and apply appropriate research.
3. Design effective
4. Apply the stages of the scientific research process from problem identification to report writing.
5. Formulate a relevant and feasible research problem considering key practical factors such as data availability and interpretation.
6. Evaluate research outcomes critically, test validity, and address ethical issues while presenting actionable recommendations.

## Course Outcomes:

At the end of the course students will be able to:

1. Understand fundamental research concepts such as constructs, hypotheses, postulates.
2. Identify and differentiate various types of research (e.g., basic, applied, analytical, empirical)
3. Develop an appropriate research and sample design, identifying stages and techniques, and recognize potential sampling errors.
4. Apply the scientific research process, from selecting a research problem to preparing the final report, including data collection, analysis, and hypothesis testing
5. Formulate a relevant and feasible research problem
6. Evaluate research outcomes by testing validity, addressing ethical issues, and proposing practical recommendations based on findings

| Module | Contents (All Modules are hands on only) | Hours | COs |
|---|---|---|---|
| I | **Module 1: Introduction and Basic Research Concepts** | 10 | 1 |
| | Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology, Need of Research in Business and Social Sciences, Objectives of Research, Issues and Problems in Research, Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical | | |
| II | **Module 2: Types of Research** | 8 | 2 |
| | Basic Research, Applied Research, Descriptive Research, Analytical Research, Empirical Research, Qualitative and Quantitative Approaches | | |
| III | **Module 3: Research Design and Sample Design** | 8 | 3 |
| | Research Design – Meaning, Types and Significance, Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors | | |
| IV | **Module 4: Research Methodology** | 6 | 4 |
| | Meaning of Research Methodology ,Stages in Scientific Research Process: Identification and Selection of Research<br>Problem, Formulation of Research Problem, Review of Literature, Formulation of Hypothesis, Formulation of research Design,<br>Sample Design , Data Collection, Data= Analysis, Hypothesis testing and Interpretation of Data, Preparation of Research Report | | |
| V | **Module 5: Formulating Research Problem** | 8 | 5 |
| | Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis | | |
| VI | **Module 6: Outcome of Research** | 5 | 6 |
| | Preparation of the report on conclusion reached, Validity Testing & Ethical Issues, Suggestions and Recommendation | | |
| | **Total** | **45** | |

## Evaluation and Assessment Scheme:

**A. Internal Assessment Examination (IAE):**
Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**
End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA) :**
Continuous Assessment should consist of the following
**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)
**Attendance (Theory & Practical)**: 05 marks
**Teacher Assessment Examination (TAE)**: 10 Marks

**List of Teacher Assessment Examination (TAE):**
1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flip Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.
D. Oral & Practical Exam
Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books**:

1. **Uma Sekaran & Roger Bougie**
   **Title**: *Research Methods for Business: A Skill Building Approach*
   **Publisher**: Wiley
2. **Donald R. Cooper & Pamela S. Schindler**
   **Title**: *Business Research Methods*
   **Publisher**: McGraw Hill
3. **Zikmund, Babin, Carr & Griffin**
   **Title**: *Business Research Methods*
   **Publisher**: Cengage Learning

**Text Books**:

1. **C.R. Kothari & Gaurav Garg**
   **Title**: *Research Methodology: Methods and Techniques*
   **Publisher**: New Age International Publishers
2. **Ranjit Kumar**
   **Title**: *Research Methodology: A Step-by-Step Guide for Beginners*
   **Publisher**: SAGE Publications

| Course Title: Foreign Language – I (German) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: V | | | Term: Odd | | | Course Code: 24OE5013C | | | | | | |
| Teaching Scheme | | | | | | Evaluation Scheme | | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | Theory | | | | Practical | Total |
| Th | Tu | Pr | Th | Tu | Pr | | IAE1 | IAE2 | ESE | CA | Or/Pr/ Tut. | |
| 3 | -- | -- | 3 | -- | -- | 3 | 20 | 20 | 60 | -- | -- | 100 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment

**Course Objectives:**

At the end of the course students will be able to:

1. Enable students to communicate basic information in German through greetings, introductions, and simple conversations.
2. Develop foundational grammar skills including verb conjugation, articles, pronouns, and sentence structure.
3. Build essential vocabulary for everyday situations, hobbies, places, family, and professions.
4. Introduce students to German culture and geography while enhancing their reading, writing, listening, and speaking abilities.

**Course Outcomes:**

At the end of the course students will be able to:

1. Introduce themselves and others, use the German alphabet, and engage in basic conversations related to profession and origin.
2. Apply fundamental grammar rules, including verb conjugations and personal pronouns, to form meaningful sentences in present tense.
3. Use appropriate vocabulary and sentence structures to talk about hobbies, countries, languages, and leisure activities.
4. Describe places, housing types, and give directions using relevant vocabulary and composite words.
5. Express daily routines and events in present and past tenses using separable verbs, question forms, and time expressions.
6. Interact effectively in real-life situations using modal verbs, prepositions, negations, and vocabulary related to places, family, and professions

| Module | Contents | Hours | COs |
|---|---|---|---|
| I | **Introduction to German Language** | 08 | CO1 |
| | • Sich begrüßen (Greetings)<br>• Sich vorstellen (Self-introduction)<br>• Das Alphabet & Deutsche Buchstabiertafel (German Alphabet & Spelling)<br>• Beruf und Herkunft angeben (Professions & Origin)<br>• Wer bin ich? (Who am I?)<br>• Andere vorstellen (Introducing Others)<br>• Telefonieren (Telephoning)<br>• Rechnen (Basic Calculations) | | |
| II | **Grammar Basics and Daily Expressions** | 08 | CO2 |
| | • Konjugation Präsens: trinken / kommen / sein<br>• Wie spät ist es? / Wie viel Uhr ist es?<br>• Die Personalpronomen<br>• Formell oder informell – du oder Sie?<br>• Begrüßung und Verabschiedung<br>• Verben – arbeiten / machen / sein<br>• Kurssprache: schreiben / lesen / hören / sprechen / sehen / markieren / ergänzen / unterstreichen / kreuzen<br>• Artikel: ein/eine/ein – kein/keine/kein – der/die/das | | |
| III | **Vocabulary Building and Communication** | 08 | CO3 |
| | • Singular/Plural – Nomen schreiben, lernen<br>• Das Wörterbuch<br>• Adjektive<br>• Was ist Ihr Hobby?<br>• Länder in Europa & Währungen<br>• Sprachen: Muttersprache / Fremdsprache<br>• Unregelmäßige Verben – sprechen / lesen / essen / sehen<br>• Was machen/tun Sie in der Freizeit? | | |
| IV | **Cultural Awareness and Descriptions** | 07 | CO4 |
| | • Die Landkarte von Europa<br>• Sehenswürdigkeiten in Indien und Europa<br>• Unsere Heimat<br>• Häuser und Wohnungstypen<br>  ○ Das Arbeitszimmer, Schlafzimmer, Küche, Balkon etc.<br>  ○ Einfamilienhaus, Altbauwohnung, Studentenwohnheim etc.<br>• Die Wohnung – Richtungen<br>• Komposita bilden – Wörter kombinieren | | |

| | | | |
|---|---|---|---|
| **V** | **Grammar Deep Dive and Routine Activities** | **07** | **CO5** |
| | • Es gibt …<br>• Subjekt/Objekt - Nominativ / Akkusativ<br>• Verben: haben, schlafen, finden (Konjugation + Akkusativ)<br>• Personalpronomen & Possessivartikel<br>• Wochentage / Wochenende<br>• Präsens / Präteritum: sein / waren, haben / hatten<br>• Der Tagesablauf / Mein Alltag<br>• Trennbare Verben<br>• Fragen: Ja/Nein-Fragen, Wann...? Wie lange ...?<br>• Die Jahreszeiten / Der Feiertag | | |
| **VI** | **Practical Usage and Modal Verbs** | **07** | **CO6** |
| | • Präpositionen: auf / unter / vor / hinter / im / in / an / über / zwischen / neben<br>• Negation: nicht / nein / nie<br>• Zahlen: Kardinalzahlen / Ordinalzahlen<br>• Wo bekommt man was? (Places & Common Phrases)<br>  ○ in der Schule, im Supermarkt, am Bahnhof, in der Bibliothek, etc.<br>• Die Familie: Beschreibung, Familienbaum, Berufe<br>• Modalverben: können, müssen, möchten, wollen, sollen, dürfen | | |
| | **Total** | **45** | |

## Evaluation and Assessment Scheme:

**A. Internal Assessment Examination (IAE):**
Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**
End Semester exam of 60 Marks will be conducted based on entire syllabus.

**Text Books:**

1. Netzwerk A1, Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, Klett Sprachen Verlag, 2024
2. Menschen A1 Kursbuch, Angela Pude and Franz Specht, Hueber Verlag, 2024
3. Berliner Platz Neu 1, Christiane Lemcke, Lutz Rohrmann, Theo Scherling, Langenscheidt Publishing Group, 2024

**Reference Books:**

1. Schritte international Neu A1.1, Daniela Niebisch, Sylvette Penning-Hiemstra, Franz Specht, Hueber Verlag, 2023
2. The Everything Learning German Book, Ed Swick, Adams Media, 2022 German Made Simple: Learn to Speak and Understand German Quickly and Easily, Arnold Leitner, Crown Publishing Group, 2021
3. Living Language German, Complete Edition, Living Language Staff, Penguin Random House, 2021

**Links for online NPTEL/SWAYAM courses:**

1. https://onlinecourses.nptel.ac.in/noc20_hs41/preview
2. https://onlinecourses.nptel.ac.in/noc21_hs30/preview

| Course Title: Basics of Marketing Management | | |
|---|---|---|
| Semester: V | Term: ODD | Course Code: 24OE5014C |
| Teaching Scheme | | Evaluation Scheme |

| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAEI | IAE2 | ESE | CA | OR/PR | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 3 | - | - | 3 | - | - | 3 | 20 | 20 | 60 | - | - | 100 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment

**Course Objectives:**

At the end of the course students will be able to:

1. Understand the fundamental concepts, scope, evolution, and significance of marketing in business and society.
2. Analyze the marketing environment and evaluate consumer behavior, segmentation, targeting, and positioning strategies.
3. Explain the key elements of product and pricing decisions, including branding, product lifecycle, and pricing strategies.
4. Examine distribution channels, promotional tools, and the role of integrated marketing communication in delivering customer value.
5. Understand the basics of digital marketing and identify the role of various online marketing channels.
6. Apply marketing principles in addressing ethical, environmental, and rural challenges, and to support innovations and startups.

**Course Outcomes:**

At the end of the course students will be able to:

1. Demonstrate knowledge of core marketing concepts and their relevance in modern business and societal contexts.
2. Assess consumer behavior, conduct market segmentation, and implement effective targeting and positioning strategies.
3. Develop appropriate product and pricing strategies, incorporating branding, packaging, and pricing methods.
4. Develop marketing plans using effective distribution systems and promotional mix strategies.
5. Distinguish between traditional and digital marketing and apply relevant digital tools for marketing decision-making.
6. Integrate concepts of green marketing, ethics, and rural marketing into real-world applications, including startups and engineering innovations.

| Module | Contents | Hours | COs |
|---|---|---|---|
| I | **Introduction to Marketing** | 06 | CO1 |
| | Definition, nature, scope, and importance of marketing | | |

| | | | |
|---|---|---|---|
| | Core marketing concepts: Needs, Wants, Demand, Value, Exchange<br>Evolution of marketing: Production to Relationship orientation<br>Role of marketing in business and society<br><br>**Self-learning Topic:** Case Study Analysis – How Apple Uses Marketing to Create Customer Value | | |
| **II** | **Understanding the Market and Consumer Behavior** | 08 | CO2 |
| | Marketing environment: Micro and Macro<br>Buyer decision process – stages and influencing factors<br>Market segmentation: Bases and strategies<br>Targeting and Positioning (STP)<br><br>**Self-learning Topic:** Consumer Behavior Models (e.g., AIDA, Maslow's Hierarchy) and Their Real-World Applications | | |
| **III** | **Marketing Mix - Product and Price** | 10 | CO3 |
| | Product: Levels, types, lifecycle, new product development<br>Branding, Packaging, and Labeling<br>Pricing: Objectives, strategies, and methods<br>Factors affecting pricing decisions<br><br>**Self-learning Topic:** Skimming vs. Penetration Pricing – Strategies Used by Tech Startups | | |
| **IV** | **Marketing Mix - Place and Promotion** | 10 | CO4 |
| | Distribution channels: Types and functions, Retailing, Wholesaling, and Logistics<br>Promotion mix: Advertising, Sales Promotion, Public Relations, Direct Marketing, Personal Selling, Integrated Marketing Communication (IMC)<br><br>**Self-learning Topic:** Role of Influencer Marketing in Brand Promotion | | |
| **V** | **Digital Marketing Basics** | 06 | CO5 |
| | Definition, nature, scope, and importance of digital marketing<br>Difference between traditional and digital marketing.<br>Overview of main online marketing channels:<br>Search Engine Optimization (SEO)<br>Search Engine Marketing (SEM)<br>Social Media Marketing (SMM)<br>Content Marketing<br>Email Marketing<br>Affiliate Marketing<br>Influencer Marketing<br>**Self-learning Topic:** Google Ads vs. Social Media Ads – ROI | | |

| | | | |
|---|---|---|---|
| | Comparison and Strategy Design | | |
| **VI** | **Social Responsibility and Applications of Marketing** | 05 | CO6 |
| | Green marketing and sustainability, Ethical issues in marketing,<br>Rural marketing in India, Applying marketing principles to engineering innovations/ startups<br>**Self-learning Topic:** Marketing Strategies for Rural India – Case of Patanjali or Amul | | |
| | **Total** | **45** | |

## Evaluation Scheme and Assessment:

**Internal Assessment Examination:**
The internal assessment consists of the following components:

| Sr. No. | Method | Marks | CO covered |
|---|---|---|---|
| 1 | Quiz- Google form | 10 | CO1 & CO2 |
| 2 | Individual Report Submission | 10 | CO3 & CO4 |
| 3 | Quiz- Google form | 10 | CO5 |
| 4 | Case Study | 10 | CO6 |

**End Semester Theory Examination:** End Semester exam of 60 Marks will be conducted based on entire syllabus.

**Reference Books:**

1. S.A. Sherlekar, Marketing Management, Himalaya Publishing.
2. Grewal & Levy, Marketing, McGraw-Hill Education.
3. Tracy L. Tuten, Principles of Marketing for a Digital Age, SAGE Publications.

**Text Books:**

1. Philip Kotler, Marketing Management, Pearson Education.
Ramaswamy & Namakumari, Marketing Management: Global Perspective Indian Context, Macmillan.

St. John College of Engineering and Management
Autonomous Institute
(A Christian Religious Minority Institution)
Approved by AICTE and DTE, Affiliated to University of Mumbai / MSBTE
DTE Code : 3218 AICTE Permanent ID : 1-4790201
NAAC Accredited with Grade 'A+', Three Programs NBA Accredited

# Bachelor of Engineering In Computer Engineering

## Final Year

**Semester – VII**

SJCEM – 24 'C' SCHEME

**Effective from Academic Year 2026-27**

**Program Structure for Final Year Computer Engineering**
**Semester – VII**
DEPARTMENT OF COMPUTER ENGINEERING

**SCHEME: SJCEM R–24 Scheme C**

| Course Code | Vertical | Course Name | Contact Hrs. | | | Credit Allotted | | | Total Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | Th | Tut | Pr | Th | Tut | Pr | |
| 24CSPCC701C | PCC | Data Warehousing and Mining | 3 | - | 2 | 3 | - | 1 | 4 |
| 24CSPCC702C | PCC | Web Programming | 2 | - | 2 | 2 | - | 1 | 3 |
| 24CSPCC70X1C | PEC | Program Elective – V | 3 | - | 2 | 3 | - | 1 | 4 |
| 24CSPCC70X2C | PEC | Program Elective – VI | 2 | - | 2 | 2 | - | 1 | 3 |
| 24OE701XC | OE | Open Elective III | 3 | - | - | 3 | - | - | 3 |
| 24CSAEC701C | AEC | Employability Enhancement Program -VI (Communication) | - | - | 2 | - | - | 1 | 1 |
| 24CSPRJ7012C | PRJ | Capstone Project | - | - | 4 | - | - | 2 | 2 |
| | | **Total** | **13** | **0** | **14** | **13** | **0** | **7** | **20** |

| Course Code | Vertical | Course Name | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| 24CSPCC701C | PCC | Data Warehousing and Mining | 20 | 20 | 60 | 25 | - | 125 |
| 24CSPCC702C | PCC | Web Programming | 20 | 20 | 60 | 25 | - | 125 |
| 24CSPCC70X1C | PEC | Program Elective - V | 20 | 20 | 60 | 25 | - | 125 |
| 24CSPCC70X2C | PEC | Program Elective - VI | 20 | 20 | 60 | 25 | - | 125 |
| 24OE701XC | OE | Open Elective III | 20 | 20 | 60 | - | - | 100 |
| 24CSAEC701C | AEC | Employability Enhancement Program -VI (Communication) | - | - | - | 25 | - | 25 |
| 24CSPRJ7012C | PRJ | Capstone Project | - | - | - | 25 | 50 | 75 |
| | | **Total** | **100** | **100** | **300** | **150** | **100** | **700** |

**Program Electives Courses**

| Program Elective | Track 01 | | Track 02 | |
|---|---|---|---|---|
| | Artificial Intelligence and Machine Learning | | Data Science | |
| Program Elective V | 24CSPCC7011C | Natural Language Processing | 24CSPCC7021C | Big Data Analytics |
| Program Elective VI | 24CSPCC7012C | Generative AI | 24CSPCC7021C | Predictive Analytics |

| Program Elective | Track 03 | | Track 04 | |
|---|---|---|---|---|
| | Network Security | | Image Processing | |
| Program Elective V | 24CSPCC7031C | Digital Forensics | 24CSPCC7041C | Virtual Reality |
| Program Elective VI | 24CSPCC7032C | Block chain | 24CSPCC7042C | Remote Sensing and GIS |

**Open Elective III Courses**

| Semester | Track 01 | | Track 02 | |
|---|---|---|---|---|
| | Entrepreneurship | | Research Methodology | |
| | Code | Subject | Code | Subject |
| VII | 24OE7011C | Finance and Accounting | 24OE7012C | Intellectual Property Rights |

| Semester | Track 03 | | Track 04 | |
|---|---|---|---|---|
| | Foreign Language | | Business Management | |
| | Code | Subject | Code | Subject |
| VII | 24OE7013C | Foreign Language I - French | 24OE7014C | Basics of HR Management |

| Course Title: Data Warehousing and Mining | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester:** VII | | | **Term:** Odd | | | | **Course Code:** 25CSPCC701C | | | | | |
| **Teaching Scheme** | | | | | | | **Evaluation Scheme** | | | | | |
| **Contact Hrs.** | | | **Credit Allotted** | | | **Total Credit** | **IAE 1** | **IAE 2** | **ESE** | **CA** | **Or/Pr/ Tut.** | **Total** |
| **Th** | **Tu** | **Pr** | **Th** | **Tu** | **Pr** | | | | | | | |
| 3 | - | 2 | 3 | - | 1 | 4 | 20 | 20 | 60 | 25 | - | 125 |

**Sustainable Development Goals Mapped:**

SDG 4: Quality Education
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation and Infrastructure

**Course Objectives:**

1. Understand the fundamentals of data warehousing, dimensional modelling, and OLAP techniques.
2. Analyse data integration processes, ETL/ELT pipelines, and data quality issues.
3. Apply data pre-processing and core data mining algorithms for knowledge discovery
4. Evaluate advanced data mining techniques and their applications in real-world scenarios.

**Course Outcomes:**

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

1. Explain the fundamental concepts, characteristics, and importance of data warehousing
2. Apply OLAP operations for multidimensional data analysis.
3. Analyze ETL/ELT pipelines and data quality challenges in data integration.
4. Perform data preprocessing and exploratory analysis on datasets.
5. Apply classification, clustering, and association rule mining techniques.
6. Evaluate advanced data mining methods and emerging trends for decision-making

| Module | Content | Hours | COs | RBT Level |
|---|---|---|---|---|
| I | **Data warehousing** | 06 | 1 | L2 |
| | Introduction to Data Warehousing, Traditional vs. Modern Data Warehouse (MDW); Characteristics of Datawarehouse.<br>Architecture: Data Lake vs. Data Warehouse vs. Data Lakehouse (Delta Lake), Medallion Architecture.<br><br>**Self-learning:** Why the Industry Moved to MDW, Case Study: How Netflix or Uber uses a Data Lakehouse for real-time recommendations. | | | |
| II | **Dimensional Modeling and Analytical Design** | 08 | 2 | L3 |
| | Dimensional Modeling: Star, Snowflake, and Fact Constellation schemas, Factless Fact tables, Slowly Changing Dimensions (SCD Types 1, 2, 3).<br>OLAP Operations: Data Cube, Roll-up, Drill-down, Slice, Dice, and Pivot.<br><br>**Self-learning:** The Unified Semantic Layer in Modern BI, Case study on selecting Granularity for a high-volume E-commerce platform. | | | |
| III | **Data Integration & Quality Engineering** | 06 | 3 | L3 |
| | ETL (Extraction, Transformation, and Loading) Vs ELT (Extract, Load, Transform). Change Data Capture (CDC): Real-time data ingestion techniques<br>Data quality issues: missing values, noise, duplicates, outliers, inconsistencies.<br><br>**Self-learning:** Data Observability and Data Contracts | | | |
| IV | **Data Mining and Pre-processing** | 07 | 4 | L4 |
| | Data Mining, Knowledge Discovery in Databases (KDD) process.<br>Data Exploration: Types of Attributes, Statistical Description of Data, Data Visualization,<br>Data Preprocessing: Data cleaning, Integration, Data transformation, Data Reduction, Discretization.<br><br>**Self-learning:** Feature engineering, Automated Data Profiling & Outlier Detection, | | | |
| V | **Core Data Mining Algorithms** | 11 | 5 | L4 |
| | Classification: decision trees - Naïve Bayes<br>Clustering overview: K-medoids, DBSCAN<br>Association Rule Mining: Market Basket Analysis, Frequent Pattern Mining, Apriori Algorithm, FP Growth. Association Rule Generation, Improving the Efficiency of Apriori, Mining Frequent Itemsets without candidate, generation, Introduction to Mining Multilevel Association Rules and Mining, Multidimensional Association Rules | | | |

| | | | | |
|---|---|---|---|---|
| | **Self-learning:** The "Curse of Dimensionality" in Clustering, Real-world MBA: How Amazon uses Association Rules for "Frequently Bought Together". | | | |
| VI | **Specialized Mining & Emerging Trends** | 07 | 6 | L2 |
| | Specialized Mining: Web & Text Mining, Spatial and Temporal Mining.<br>Emerging Trends: Graph & Social Media Mining, AI-Augmented & Multimedia Mining, Privacy & Ethics in Mining.<br><br>**Self-learning:** Privacy-Preserving Data Mining, Federated Learning,<br><br>**Advanced topic:** Explainable AI (XAI) in Data Mining | | | |
| **Total** | | **45** | | |

| Sr No. | List of Experiment | COs |
|---|---|---|
| 1 | To study and compare Data Warehouse, Data Lake, and Data Lakehouse architectures based on structure, features, and use cases. | 1 |
| 2 | Design of data warehouse schema for a given application. (Retail/ Library/ Banking) | 1 |
| 3 | Implementation of all dimension table and fact table. | 2 |
| 4 | Perform OLAP operations such as roll-up, drill-down, slice, dice, and pivot using SQL queries. | 2 |
| 5 | Implement an ETL process by extracting data from a source, transforming it, and loading it into a database. | 3 |
| 6 | Identify and handle data quality issues such as missing values, duplicates, and outliers in a dataset. | 3 |
| 7 | Perform statistical analysis and visualization to understand the characteristics of a dataset. | 4 |
| 8 | Apply data preprocessing techniques such as normalization, transformation, and discretization. | 4 |
| 9 | Implement classification algorithms such as Decision Tree or Naïve Bayes for predictive analysis. | 5 |
| 10 | Perform association rule mining using the Apriori algorithm for market basket analysis. | 5 |
| 11 | Perform sentiment analysis on text data to classify it into positive or negative categories. | 6 |
| 12 | Analyze a real-world dataset using data mining techniques and derive meaningful insights. | 6 |

**Evaluation and Assessment Scheme:**

**A. Internal Assessment Examination (IAE):**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other.

**Note**: Number of activities to be conducted under TAE would be as per the subject need.

**Reference Books:**

1. Ralph Kimball and Margy Ross, *"The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling"*, Wiley, 3rd edition.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, *"Introduction to Data Mining"*, Pearson, 2nd edition.
3. Ian H. Witten, Eibe Frank and Mark A. Hall, *"Data Mining: Practical Machine Learning Tools and Techniques"*, Morgan Kaufmann, 3rd edition.
4. Jiawei Han, Micheline Kamber and Jian Pei, *"Data Mining: Concepts and Techniques"*, Morgan Kaufmann, 3rd edition.
5. Paulraj Ponniah, *"Data Warehousing: Fundamentals for IT Professionals"*, Wiley India.

**Text Books:**

1. Jiawei Han, Micheline Kamber and Jian Pei, *"Data Mining: Concepts and Techniques"*, Morgan Kaufmann, 3rd edition.
2. Paulraj Ponniah, *"Data Warehousing: Fundamentals for IT Professionals"*, Wiley India.
3. M.H. Dunham, *"Data Mining: Introductory and Advanced Topics"*, Pearson Education.
4. Reema Thareja, *"Data Warehousing"*, Oxford University Press.
5. Alex Berson and Stephen J. Smith, *"Data Warehousing, Data Mining and OLAP"*, McGraw Hill.
6. Pieter Adriaans and Dolf Zantinge, *"Data Mining"*, Addison Wesley.

**Useful Links:**

1. https://onlinecourses.nptel.ac.in/noc20_cs12/preview
2. https://www.coursera.org/specializations/data-mining

| Course Title: Web Programming | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester:** VII | | | **Term:** Odd | | | | **Course Code:** 24CSPCC702C | | | | | |
| **Teaching Scheme** | | | | | | | **Evaluation Scheme** | | | | | |
| **Contact Hrs.** | | | **Credit Allotted** | | | **Total Credit** | **IAE 1** | **IAE 2** | **ESE** | **CA** | **Or/Pr/ Tut.** | **Total** |
| **Th** | **Tu** | **Pr** | **Th** | **Tu** | **Pr** | | | | | | | |
| 2 | - | 2 | 2 | - | 1 | 3 | 20 | 20 | 60 | 25 | - | 125 |

**Sustainable Development Goals Mapped:**

**Course Objectives:**

1. Understand the fundamental architecture of the World Wide Web and client-server protocols.
2. Master structural and presentational web design using HTML5 and CSS3.
3. Implement dynamic client-side functionality and DOM manipulation using JavaScript.
4. Develop responsive, mobile-first user interfaces using modern CSS frameworks.
5. Build scalable server-side applications and manage persistent data in databases.
6. Integrate asynchronous communication and APIs to create seamless single-page experiences.

**Course Outcomes:**

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

1. Design valid, accessible, and semantic web pages using HTML5.
2. Apply advanced CSS3 techniques, including Flexbox and Grid, for complex layouts.
3. Write interactive scripts to handle events and validate data on the client side.
4. Utilize server-side technologies (e.g., Node.js or PHP) to process user requests.
5. Perform CRUD operations by connecting web applications to backend databases.
6. Deploy a full-stack web application utilizing AJAX, JSON, and RESTful principles.

| Module | Content | Hours | COs | RBT Level |
|---|---|---|---|---|
| 1 | **Web Foundation & Semantic Markup** | 5 | 1 | L6 |
| | 1. The Request-Response Cycle & Web Standards 2. HTML5 Semantic Elements & Accessibility (A11y) 3. Advanced Forms, Validation, and Media Embedding 4. The CSS Cascade: Specificity, Inheritance, and Box Model 5. **Self Learning** -Visual Effects: Shadows, Gradients, and CSS Transitions | | | |
| II | **Responsive Architecture & Layout** | 5 | 2 | L3 |
| | 1. Flexbox Fundamentals for One-Dimensional Layouts 2. CSS Grid Systems for Two-Dimensional Design 3. Mobile-First Strategies & Advanced Media Queries 4. CSS Architecture: BEM Methodology and SASS **Self Learning** :5. Utility-First vs. Component-Based Frameworks | | | |
| III | **Client-Side Scripting & Interactivity** | 5 | 3 | L6 |
| | 1. Modern JS: Scoping, Closures, and Data Structures 2. ES6+ Evolution: Modules, Destructuring, and Spread 3. High-Performance DOM Manipulation & Bubbling 4. Functional Programming Concepts in JavaScript, **Self Learning**: Front-End Tooling: Bundlers and Task Runners | | | |
| IV | **Server-Side Engineering** | 5 | 4 | L6 |
| | 1. The Backend Environment: Node.js Architecture 2. Dependency Management with NPM/Yarn 3. Building RESTful Routing with Express.js 4. Templating Engines vs. Static Site Generation 5. Authentication: Sessions, **Self Learning:** Cookies, and Security Headers | | | |
| V | **Database Integration & Data Persistence** | 5 | 5 | L6 |
| | 1. Relational vs. Document-Based Data Modelling 2. Designing Scalable Schema for Web Applications 3. Database Drivers & ORM/ODM Integration 4. Transactional Integrity and CRUD Implementation 5. Web Security: Sanitization & **Self Learning** :Protection against OWASP Top 10 | | | |
| VI | **Full-Stack Orchestration & Deployment** | 5 | 6 | L3 |
| | 1. Asynchronous Patterns: The Event Loop & Async/Await 2. The Fetch API and State Management 3. Consuming and Authoring RESTful APIs (JSON) 4. Secure Communication: JWT and OAuth 2.0 5. CI/CD Pipelines, Git Workflow, and **Self Learning**: Cloud Hosting | | | |
| **Total** | | **30** | | |

| Sr No. | List of Experiment | COs |
|---|---|---|
| 1 | Develop a semantic, multi-page technical documentation site. | 1 |
| 2 | Create a complex survey form with HTML5 constraints and ARIA labels. | 1 |
| 3 | Build a responsive e-commerce gallery using CSS Grid and "Holy Grail" layout. | 2 |
| 4 | Implement a dark/light mode toggle using CSS Custom Properties (Variables). | 2 |
| 5 | Build a real-time search filter for a list of items using JavaScript strings/arrays. | 3 |
| 6 | Create a drag-and-drop interface using the HTML5 Drag and Drop API. | 3 |
| 7 | Develop a Node.js microservice that processes and logs incoming JSON data. | 4 |
| 8 | Implement custom middleware for user authorization in an Express app. | 4 |
| 9 | Design a blog database and write scripts to seed it with mock data. | 5 |
| 10 | Build a "User Profile" system that saves and edits data in a live database. | 5 |
| 11 | Develop a Single Page Application (SPA) dashboard that polls a REST API. | 6 |
| 12 | Perform a "Live Launch": Deploy a Git-connected app to a production URL. | 6 |

**Evaluation and Assessment Scheme:**

**A. Internal Assessment Examination (IAE):**
Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**
End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**
Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs should be covered)
**Attendance (Theory & Practical):** 05 marks
**Teacher Assessment Examination (TAE):** 10 Marks
**List of Teacher Assessment Examination (TAE):**

12. Assignment
13. Case Study
14. Debate
15. Solution for Social Problems
16. Field Visit
17. Group Project
18. Flipped Classroom
19. Topic Review

20. Quiz
21. Mind Mapping
22. Any other.

**Note**: Number of activities to be conducted under TAE would be as per the subject need.

**Reference Books:**

1. *Learning Web Design* (6th Edition) – Jennifer Robbins.
2. *JavaScript: The Definitive Guide* (7th Edition) – David Flanagan.
3. *HTML and CSS: Visual QuickStart Guide* – Casabona & Castro.
4. *Eloquent JavaScript* (4th Edition) – Marijn Haverbeke.
5. *Node.js Web Development* – David Herron.
6. *Full Stack Web Development with Cloud and Serverless* – O'Reilly Media.

**Text Books:**

1. *Refactoring UI* – Adam Wathan & Steve Schoger.
2. *You Don't Know JS Yet* – Kyle Simpson.
3. *Don't Make Me Think (Revisited)* – Steve Krug.
4. *Programming JavaScript Applications* – Eric Elliott.
5. *Web Security for Developers* – Malcolm McDonald.
6. *Git Pocket Guide* – Richard E. Silverman.

**Useful Links:**

1. The Complete 2026 Web Development Bootcamp (Udemy).
2. Full Stack Open (University of Helsinki).
3. Modern JavaScript from the Beginning (Brad Traversy).
4. Learn Professional Web Development (MDN Plus).

| Course Title: Natural Language Processing | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: VII | | | Term: ODD | | | | Course Code: 25CSPEC7011 C | | | | | |
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 3 | - | 2 | 3 | - | 1 | 4 | 20 | 20 | 60 | 25 | - | 125 |

**Sustainable Development Goals Mapped:**

SDG 4: Quality Education
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation and Infrastructure
SDG 10: Reduced Inequalities
SDG 16: Peace, Justice & Strong Institutions

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

**Course Objectives:**

1. Understand linguistic and computational foundations of NLP
2. Apply statistical and machine learning techniques to text data
3. Explore deep learning architectures for NLP
4. Develop NLP-based applications
5. Understand Transformers, LLMs, and Generative AI

**Course Outcomes:**

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

1. Explain NLP concepts and challenges
2. Apply preprocessing and feature engineering
3. Analyze syntactic and semantic structures
4. Implement ML/DL-based NLP models
5. Develop real-world NLP applications
6. Apply Transformers and LLMs with ethical considerations

| Module | Contents | Hours | COs |
|---|---|---|---|
| I | **Module 1: Foundations of NLP** | 6 | CO1 |
| | Introduction, scope, applications, Levels: Morphology, Syntax, Semantics, Pragmatics, NLP pipeline and challenges<br>**Self-Learning Topics:** History and evolution of NLP, Rule-based vs statistical vs neural NLP, Applications of NLP, Challenges in NLP(ambiguity, multilingual issues), NLP tools and libraries, Ethics and introduction to Generative AI | | |
| II | **Module 2: Text Processing & Language Models** | 8 | CO2 |
| | Tokenization, stemming, lemmatization, Regular expressions<br>N-gram models, smoothing techniques, Feature extraction: BoW, TF-IDF.<br>**Self-Learning Topics:** Advanced preprocessing and regex applications, Feature engineering and embeddings, Language model evaluation and smoothing, Tokenization techniques (BPE, WordPiece) Handling OOV and real-world NLP datasets | | |
| III | **Module 3: Syntax & Parsing** | 8 | CO3 |
| | POS tagging, CFG and parsing techniques, HMM and Viterbi algorithm, Dependency parsing.<br>**Self-Learning Topics:** Advanced POS tagging techniques (CRF, BiLSTM-based tagging), Comparison of parsing approaches (Constituency vs Dependency parsing), Treebank annotation standards (Penn Treebank, Universal Dependencies), Ambiguity resolution in parsing, Transition-based vs Graph-based dependency parsing<br>Error analysis in parsing systems, Case study - Syntax analysis in machine translation systems. | | |
| IV | **Module 4: Semantics & Information Extraction** | 8 | CO4 |
| | Word Sense Disambiguation, Named Entity Recognition, Semantic Role Labeling, Information extraction.<br>**Self-Learning Topics:** Knowledge graphs and semantic networksOntology development (WordNet, ConceptNet), Advanced Named Entity Recognition using deep learning, Semantic similarity and sentence embeddings (SBERT), Question answering systems (basic architecture), Coreference resolution techniques, Case study: Information extraction from news articles | | |
| V | **Module 5: ML & Deep Learning for NLP** | 8 | CO5 |

| Module | Contents | Hours | COs |
|---|---|---|---|
| | Text classification (Naïve Bayes, SVM), Neural networks for NLP RNN, LSTM, GRU, Word embeddings: Word2Vec, GloVe. **Self-Learning Topics:** Comparison of ML vs Deep Learning approaches in NLP, Hyperparameter tuning in NLP models, Transfer learning in NLP, Attention mechanism (basic concept), Limitations of RNN/LSTM models, Evaluation metrics: Precision, Recall, F1-score, Case study - Sentiment analysis using LSTM vs traditional ML models. | | |
| **VI** | **Module 6: Transformers, LLMs & Generative AI** | **7** | **CO6** |
| | Transformer Architecture: Attention mechanism, Self-attention and multi-head attention, Encoder–decoder architecture. Pre-trained Models: BERT (Bidirectional Encoder Representations), GPT (Generative Pre-trained Transformer), Transfer learning & fine-tuning, Large Language Models (LLMs): Concept and working of LLMs, Prompt engineering, Retrieval-Augmented Generation (RAG), Applications: Chatbots, summarization, QA systems, Ethical & Practical Issues: Bias, fairness, hallucination, Privacy and responsible AI. **Self-Learning Topics:** In-depth study of Attention mechanism, BERT vs GPT vs T5 comparison, Fine-tuning vs prompt engineering Retrieval-Augmented Generation (RAG), Hallucination problem in LLMs, Open-source LLMs (LLaMA, Mistral – overview), Ethical AI and responsible NLP, Case study - Chatbot using LLM (design and evaluation) | | |
| | **Total** | **45** | |

**List of Experiments:**

| Sr. No. | Title of Experiment | COs Mapped |
|---|---|---|
| 1 | Apply various text preprocessing techniques for any given text : Tokenization, Filtration & Script Validation, Stop Word, Removal, Lemmatization / Stemming. | CO2 |
| 2 | Implement N-Gram model for the given text input. | CO2 |
| 3 | Perform morphological analysis and word generation for any given text. | CO1 |
| 4 | Study the different POS taggers and Perform POS tagging on the given text. | CO3 |
| 5 | Implement Named Entity Recognizer for the given text input. | CO4 |
| 6 | Implementation of Sentiment analysis using LSTM (ML-based). | CO5 |
| 7 | Implementation of Text classification using ML. | CO5 |
| 8 | Implementation of Word embeddings (Word2Vec) | CO5 |
| 9 | Implementation of LSTM-based text generation. | CO5 |

| Sr. No. | Title of Experiment | COs Mapped |
|---|---|---|
| 10 | Implementation of Transformer model using HuggingFace. | CO6 |
| 11 | Implementation of Chatbot using LLM API | CO6 |
| 12 | Mini Project: Study various applications of NLP and Formulate the Problem Statement for Mini Project based on chosen real world NLP applications. | CO6 |

**Evaluation Scheme and Assessment:**

**A. Internal Assessment Examination:**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination:**

End Semester exam of 60 Marks will be conducted based on the entire syllabus.

**C. Continuous Assessment (CA):**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any Other

**Note:** Number of activities to be conducted under TAE would be as per the subject needed.

**D. Oral & Practical Exam:**

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Lewis Tunstall – *Transformers for NLP*
2. Sinan Ozdemir – *Quick Start Guide to LLMs*
3. HuggingFace Documentation

**Text Books:**

1. urafsky & Martin – *Speech and Language Processing*
2. Manning & Schütze – *Foundations of Statistical NLP*
3. Steven Bird – *NLP with Python*

**Useful Links:**

1. NPTEL – Applied Natural Language Processing
2. NPTEL – Deep Learning for NLP
3. NPTEL – NLP (IIT Bombay Lecture Series)

# Course Title: Generative AI

| Semester: VII | | | Term: ODD | | | Course Code: 25CSPEC7012C | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | | | | Evaluation Scheme | | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 02 | - | 02 | 02 | - | 01 | 03 | 20 | 20 | 60 | 25 | - | 125 |

**Sustainable Development Goals Mapped:**
SDG 4: Quality Education,
SDG 9: Industry, Innovation and Infrastructure,
SDG 8: Decent Work and Economic Growth

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

**Course Objectives:**

1. Understand foundations of AI, NLP and Generative AI.
2. Apply text processing and embeddings for AI systems.
3. Explore Transformer models and Large Language Models.
4. Develop prompt-based and real-world GenAI applications.
5. Understand ethical and responsible AI practices.

**Course Outcomes:**

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

1. Explain Generative AI concepts and applications.
2. Apply preprocessing and embeddings for language tasks.
3. Analyze Transformer and LLM architectures.
4. Build prompt-based AI solutions.
5. Develop real-world Generative AI applications.
6. Evaluate ethical, bias and privacy issues in AI systems.

| Module | Contents | Hours | COs | RBT Level |
|---|---|---|---|---|
| **I** | **Foundations of Generative AI** | **04** | **CO1** | **2** |
| | Introduction to Artificial Intelligence, Machine Learning, Deep Learning and Natural Language Processing. Need and evolution of Generative AI. Difference between Predictive AI and Generative AI. Types of Generative AI systems for text, image, code, audio and video generation. Applications in education, healthcare, finance, software development and customer support. Advantages, limitations and challenges of Generative AI. **Self-Learning Topics:** History of AI, current GenAI tools, future trends. | | | |
| **II** | **Text Processing and Embedding** | **05** | **CO2** | **4** |
| | Text preprocessing pipeline, Sentence segmentation and tokenization. Stop-word removal, stemming and lemmatization. Handling noisy text, emojis and multilingual text. Subword tokenization: Byte Pair Encoding (BPE), WordPiece. Word representation using Bag of Words, TF-IDF. Word embeddings: Word2Vec, GloVe. Sentence embeddings and semantic similarity. **Self-Learning Topics:** Vector databases, embeddings visualization. | | | |
| **III** | **Deep Learning for Language Generation** | **05** | **CO3** | **3** |
| | Introduction to neural networks for text data. Recurrent Neural Networks (RNN). Vanishing gradient problem. Long Short-Term Memory (LSTM). GRU networks. Sequence-to-Sequence architecture for translation and summarization. Basic attention mechanism. Use cases of RNN/LSTM in text generation. **Self-Learning Topics:** Text generation using LSTM. | | | |
| **IV** | **Transformers & Large Language Models** | **06** | **CO4** | **3** |
| | Need for Transformers over RNN models. Transformer architecture overview. Encoder and Decoder blocks. Self-attention mechanism. Multi-head attention. Positional encoding. Pretraining and fine-tuning concepts. Overview of BERT, GPT and T5 models. Introduction to Large Language Models (LLMs), scaling and capabilities. **Self-Learning Topics:** GPT vs BERT comparison. | | | |
| **V** | **Prompt Engineering & Applications** | **05** | **CO5** | **4** |
| | Introduction to prompt engineering. Prompt structure and prompt design principles. Zero-shot prompting. One-shot and Few-shot prompting. Chain-of-Thought | | | |

| Module | Contents | Hours | COs | RBT Level |
|---|---|---|---|---|
| | prompting. Role prompting and instruction prompting. Introduction to Retrieval-Augmented Generation (RAG). Applications: Chatbots, question answering, summarization, translation, code generation, content creation.<br>**Self-Learning Topics:** Prompt optimization case studies. | | | |
| **VI** | **Responsible AI & Deployment** | **05** | **CO6** | **5** |
| | Bias and fairness in AI models. Hallucination problem in LLMs. Privacy, security and misuse risks. Responsible AI principles. Evaluation metrics: Accuracy, Precision, Recall, F1-score, BLEU, ROUGE. Using APIs for deploying AI applications. Cloud-based GenAI services overview. Future scope of Generative AI.<br>**Self-Learning Topics** | | | |
| | **Total** | **30** | | |

**List of Experiments:**

| Sr. No. | Title of Experiment | COs Mapped |
|---|---|---|
| 1 | Study and compare various Generative AI tools/platforms (ChatGPT, Gemini, Claude, Copilot etc.) based on features, applications, strengths and limitations. | CO1 |
| 2 | Apply various text preprocessing techniques: tokenization, stop-word removal, stemming, lemmatization using Python libraries. | CO2 |
| 3 | Implement text representation using Bag of Words and TF-IDF for a given dataset. | CO2 |
| 4 | Implement sequence prediction / text generation using RNN or LSTM model. | CO3 |
| 5 | Implement Transformer model using HuggingFace library for text generation or classification. | CO4 |
| 6 | Perform prompt engineering tasks using Zero-shot, Few-shot and Chain-of-Thought prompting. | CO5 |
| 7 | Build a chatbot using LLM API (OpenAI / Gemini / open-source model). | CO5 |
| 8 | Implement text summarization / translation using pre-trained LLM or Transformer model. | CO5 |
| 9 | Evaluate AI outputs for bias, hallucination, fairness and responsible usage. | CO6 |
| 10 | Mini Project: Develop a real-world Generative AI application (chatbot, content generator, QA system, coding assistant, etc.). | CO5, CO6 |

**Evaluation Scheme and Assessment:**

**A. Internal Assessment Examination:**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination:**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any Other

**Note:** Number of activities to be conducted under TAE would be as per the subject need.

**D. Oral & Practical Exam:**

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Ozdemir, Sinan, Quick Start Guide to Large Language Models: Strategies and Best Practices for Using ChatGPT and Other LLMs, Addison-Wesley Professional / Pearson, 1st Edition (2024)
2. Foster, David, Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, O'Reilly Media, 2nd Edition (2023)
3. Huyen, Chip, AI Engineering: Building Applications with Foundation Models, O'Reilly Media, 1st Edition (2025)
4. Iusztin, Paul and Labonne, Maxime, The LLM Engineering Handbook, Packt Publishing, 1st Edition (2025)

**Text Books:**

1. Jurafsky, Daniel and Martin, James H. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education, 2nd Edition
2. Tunstall, Lewis; von Werra, Leandro; Wolf, Thomas, Natural Language Processing with Transformers, O'Reilly Media, 1st Edition (2022)
3. Goodfellow, Ian; Bengio, Yoshua; Courville, Aaron, Deep Learning, MIT Press, 1st Edition (2016)
4. Raschka, Sebastian, Build a Large Language Model (From Scratch), Manning Publications, 1st Edition (2024)

**Useful Links:**

1. Hugging Face LLM Course: https://huggingface.co/learn/llm-course/
2. Hugging Face Documentation: https://huggingface.co/docs
3. OpenAI API Documentation: https://platform.openai.com/docs
4. Google AI / Gemini Documentation: https://ai.google.dev
5. LangChain Documentation: https://python.langchain.com
6. NPTEL Courses : https://nptel.ac.in
7. Coursera – Generative AI Courses: https://www.coursera.org
8. Kaggle Learn – NLP & AI Courses: https://www.kaggle.com/learn

| Course Title: Big Data Analytics | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester: VII | | | Term: ODD | | | | Course Code: 24CSPEC7022C | | | | | |
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 3 | - | 2 | 3 | - | 1 | 4 | 20 | 20 | 60 | 25 | - | 125 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment

## Course Objectives:

1. To provide an overview of the big data platforms, its use cases and Hadoop ecosystem.
2. To introduce programming skills to build simple solutions using big data technologies such as Map Reduce, Scripting for No SQL and R
3. To learn the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
4. To enable students to have skills that will help them to solve complex real-world problems for decision support.

## Course Outcomes:

At the end of the course students will be able to:

1. Understand the building blocks of Big Data Analytics.
2. Apply fundamental enabling techniques like Hadoop and Map Reduce in solving real world problems.
3. Understand different NoSQL systems and how it handles big data.
4. Apply advanced techniques for emerging applications like stream analytics.
5. Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications, etc.
6. Apply statistical computing techniques and graphics for analysing big data.

| Module | Contents | Hours | COs |
|---|---|---|---|
| I | **Introduction to Big Data and Hadoop** | | |
| | • Introduction to Big Data - Big Data characteristics and Types of Big Data<br>• Traditional vs. Big Data business approach<br>• Case Study of Big Data Solutions<br>• Concept of Hadoop, Core Hadoop Components; Hadoop Ecosystem<br><br>**Self-Learning topics**: Benefits of big Data Analytics | 03 | CO1 |
| II | **Hadoop HDFS and Map Reduce** | | |
| | • Distributed File Systems: Physical Organization of Compute Nodes, Large- Scale File-System Organization.<br>• Map Reduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of Map Reduce Execution, Coping With Node Failures.<br>• Algorithms Using Map Reduce: Matrix-Vector Multiplication by Map Reduce, Relational-Algebra Operations, Computing Selections by Map Reduce, Computing Projections by Map Reduce, Union ,Intersection, and Difference by Map Reduce<br>• Hadoop Limitations<br><br>**Self-Learning topics:** Map Reduce, Distributed File System | 09 | CO2 |
| III | **NoSQL** | | |
| | • Introduction to NoSQL, NoSQL Business Drivers<br>• NoSQL Data Architecture Patterns: Key-value stores, Graph stores, Column family (Big table)stores, Document stores, Variations of NoSQL architectural patterns, NoSQL Case Study<br>• NoSQL solution for big data, Understanding the types of big data problems; analyzing big data with a shared-nothing architecture; choosing distribution models: master-slave versus peer-to-peer; NoSQL systems to handle big data problems.<br><br>**Self-Learning topics:** Relational and Non-relational Database | 11 | CO3 |
| IV | **Mining Data Streams** | | |
| | • The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing.<br>• Sampling Data techniques in a Stream<br>• Filtering Streams: Bloom Filter with Analysis.<br>• Counting Distinct Elements in a Stream, Count- Distinct Problem, Flajolet-Martin Algorithm, Combining Estimates, Space Requirements<br>• Counting Ones in a Window: The Cost of Exact Counts, the Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm, Decaying Windows.<br><br>**Self-Learning topics:** Stream Queries, Sampling Data Techniques | 12 | CO4 |

| | | | |
|---|---|---|---|
| V | Real-Time Big Data Models | | |
| | • A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering<br>• Case Study: Product Recommendation<br>• Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities in a social graph<br>Self-Learning topics: Recommendations Systems, Models | 05 | CO5 |
| VI | Data Analytics with R | | |
| | • Exploring Basic features of R, Exploring RGUI, Exploring RStudio, Handling Basic Expressions in R, Variables in R, Working with Vectors, Storing and Calculating Values in R, Creating and using Objects, Interacting with users, Handling data in R workspace, Executing Scripts, Creating Plots, Accessing help and documentation in R.<br>• Reading datasets and Exporting data from R, Manipulating and Processing Data in R, Using functions instead of script, built-in functions in R<br>• Data Visualization: Types, Applications<br>Self-Learning topics: "R" Programming, Introduction to R and its applica- tions, Downloading and installing R and R-Studio | 05 | CO6 |
| | **Total** | **45** | |

## List of Experiments

| Sr. No. | Name of the Experiment |
|---|---|
| 1 | Hadoop HDFS Practical:<br>-HDFS Basics, Hadoop Ecosystem Tools Overview.<br>-Installing Hadoop.<br>-Copying File to Hadoop.<br>-Copy from Hadoop File system and deleting file.<br>-Moving and displaying files in HDFS.<br>-Programming exercises on Hadoop |
| 2 | Use of Sqoop tool to transfer data between Hadoop and relational database servers.<br>a. Sqoop - Installation.<br>b. To execute basic commands of Hadoop eco system component Sqoop. |
| 3 | To install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL commands |
| 4 | Experiment on Hadoop Map-Reduce:<br>-Write a program to implement a word count program using MapReduce. |
| 5 | Experiment on Hadoop Map-Reduce:<br>-Implementing simple algorithms in Map-Reduce: Matrix multiplication, Aggregates, Joins, Sorting, Searching, etc |

| | |
|---|---|
| 6 | Create HIVE Database and Descriptive analytics-basic statistics. |
| 7 | Data Stream Algorithms (any one):<br>- Implementing DGIM algorithm using any Programming Language<br>- Implement Bloom Filter using any programming language Implement Flajolet Martin algorithm using any programming language |
| 8 | Social Network Analysis using R (for example: Community Detection Algorithm) |
| 9 | Data Visualization using Hive/PIG/R/Tableau/. |
| 10 | Exploratory Data Analysis using Spark/ Pyspark. |
| 11 | Mini Project: One real life large data application to be implemented (Use standard Datasets available on the web).<br>- Streaming data analysis – use flume for data capture, HIVE/PYSpark for analysis of twitter data, chat data, weblog analysis etc.<br>- Recommendation System (for example: Health Care System, Stock Market Prediction, Movie Recommendation, etc.)<br>SpatioTemporal DataAnalytics |

## Evaluation and Assessment Scheme:

**A. Internal Assessment Examination (IAE):**

Assessment consists of two class tests, each 10 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**

End Semester exam of 30 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA) :**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flip Classroom

8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

**D. Oral & Practical Exam**

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Bill Franks , —Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data
2. Streams with Advanced Analytics, Wiley
3. Chuck Lam, —Hadoop in Action, Dreamtech Press
4. Jared Dean, —Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners, Wiley India Private Limited, 2014.
5. Jiawei Han and Micheline Kamber, —Data Mining: Concepts and Techniques‖, Morgan Kaufmann Publishers, 3rd ed, 2010.
6. Lior Rokach and Oded Maimon, —Data Mining and Knowledge Discovery Handbook, Springer, 2nd edition, 2010.
7. Ronen Feldman and James Sanger, —The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, 2006.
8. Vojislav Kecman, —Learning and Soft Computing‖, MITPress, 2010

**Text Books:**

1. Cre Anand Rajaraman and Jeff Ullman —Mining of Massive Datasets‖, Cambridge UniversityPress
2. Alex Holmes —Hadoop in Practice‖, Manning Press, Dreamtech Press.
3. Dan Mcary and Ann Kelly —Making Sense of NoSQL‖ – A guide for managers and the rest of us, Manning Press.
4. DT Editorial Services, —Big Data Black Book‖, Dreamtech Press
5. EMC Education Services,‖Data Science and Big Data Analytics‖,Wiley

**Useful Links:**

1. https://nptel.ac.in/courses/106104189
2. https://www.coursera.org/specializations/big-data#courses
3. https://www.digimat.in/nptel/courses/video/106106169/L01.html
4. https://www.coursera.org/learn/nosql-databases#syllabus
5. https://www.coursera.org/learn/basic-recommender-systems#syllabus

| Course Title: Predictive Analytics | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester:** VII | | | **Term:** Odd | | | | **Course Code:** 24CSPCC7021C | | | | | |
| **Teaching Scheme** | | | | | | | **Evaluation Scheme** | | | | | |
| **Contact Hrs.** | | | **Credit Allotted** | | | **Total Credit** | **IAE 1** | **IAE 2** | **ESE** | **CA** | **Or/Pr/ Tut.** | **Total** |
| **Th** | **Tu** | **Pr** | **Th** | **Tu** | **Pr** | | | | | | | |
| 2 | - | 2 | 2 | - | 1 | 3 | 20 | 20 | 60 | 25 | - | 125 |

**Sustainable Development Goals Mapped:**
SDG 4: Quality Education
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation and Infrastructure
SDG 3: Good Health and Well-being

**Course Objectives:**

1. Understand the fundamentals of predictive analytics and data preprocessing
2. Apply machine learning techniques for prediction tasks
3. Analyze data using clustering and classification algorithms
4. Build predictive models using neural networks and deep learning
5. Evaluate model performance and apply ensemble methods
6. Explore real-world applications of predictive analytics

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

1. Explain predictive analytics concepts and preprocessing techniques
2. Apply classification algorithms for prediction
3. Analyze clustering techniques and patterns
4. Build neural network models
5. Evaluate models using ensemble techniques
   Develop real-world predictive applications

| Module | Content | Hours | COs | RBT Level |
|---|---|---|---|---|
| I | **Introduction & Data Preprocessing** | 5 | CO1 | L2 |
| | Predictive analytics vs data mining, Types of data and datasets, Data cleaning, transformation, normalization, Feature selection and dimensionality reduction, Evaluation metrics (Accuracy, Precision, Recall, F1-score)<br><br>**Self-Learning:** Feature Engineering Techniques | | | |
| II | **Classification Techniques** | 6 | CO2 | L3 |
| | Supervised learning concepts, Algorithms: Naive Bayes K-Nearest Neighbors (KNN) Support Vector Machine (SVM), Overfitting & under fitting, Model validation techniques<br><br>**Self-Learning:** Hyper parameter Tuning Techniques | | | |
| III | **Clustering Technique** | 5 | CO3 | L4 |
| | Unsupervised learning, K-Means clustering, Hierarchical clustering, Expectation-Maximization (EM), Cluster evaluation<br><br>**Self Learning:** Dimensionality Reduction using PCA | | | |
| IV | **Artificial Neural Networks** | 5 | CO4 | L5 |
| | Biological vs artificial neuron, Perceptron model, Multilayer neural networks, Activation functions, Backpropagation algorithm<br><br>**Self Learning:** Vanishing Gradient Problem and Optimization Techniques | | | |
| V | **Deep Learning & Ensemble Learning** | 5 | CO5 | L5 |
| | Deep Neural Networks (DNN),Convolutional Neural Networks (CNN) basics, Ensemble methods: Bagging,Boosting,Random Forest, Improving model performance<br><br>**Self Learning:** Dropout and regularization,Transfer learning | | | |
| VI | **NLP & Applications** | 4 | CO6 | L4 |
| | Basics of Natural Language Processing,Text preprocessing & sentiment analysis,<br>Applications in: Healthcare,Finance,Marketing Case study<br><br>**Self Learning:** Transformer models basics<br><br>**Advance Topic:** Explainable AI (XAI), Federated Learning | | | |
| **Total** | | **30** | | |

| Sr No. | List of Experiment | COs |
|---|---|---|
| 1 | Data Loading and Exploratory Data Analysis using Pandas | 1 |
| 2 | Data Preprocessing: Handling Missing Values, Encoding, Normalization | 1 |
| 3 | Implementation of Naive Bayes Classifier | 2 |
| 4 | Implementation of K-Nearest Neighbors (KNN) | 2 |
| 5 | Implementation of Support Vector Machine (SVM) | 2 |
| 6 | Implementation of K-Means Clustering with Elbow Method | 3 |
| 7 | Implementation of Hierarchical Clustering with Dendrogram | 3 |
| 8 | Implementation of Single Layer Perceptron | 4 |
| 9 | Implementation of Multilayer Neural Network using Keras/TensorFlow | 4 |
| 10 | Implementation of Random Forest (Ensemble Learning) | 5 |
| 11 | Implementation of Boosting Algorithm (AdaBoost/Gradient Boosting) | 5 |
| 12 | Sentiment Analysis using NLP Techniques | 6 |

**Evaluation and Assessment Scheme:**

**A. Internal Assessment Examination (IAE):**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**

End Semester exam of 60 Marks will be conducted based on the entire syllabus.

**C. Continuous Assessment (CA):**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate

4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other.

**Note**: Number of activities to be conducted under TAE would be as per the subject need.

**Reference Books:**

1. Witten et al., Data Mining: Practical Machine Learning Tools and Techniques
2. Géron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow
3. Müller & Guido, Introduction to Machine Learning with Python
4. Goodfellow et al., Deep Learning
5. Abbott, Applied Predictive Analytics

**Text Books:**

1. Kelleher et al., Fundamentals of Machine Learning for Predictive Data Analytics
2. Larose & Wali, Data Mining and Predictive Analytics

**Useful Links:**

1. https://www.coursera.org/specializations/data-science-python
2. https://www.coursera.org/specializations/deep-learning
3. https://www.coursera.org/learn/machine-learning

# Course Title: Digital Forensic

| Semester: VII | | | Term: ODD | | | | Course Code: 24CSPCC7031C | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 3 | - | 2 | 3 | - | 1 | 4 | 20 | 20 | 60 | 25 | - | 125 |

**Sustainable Development Goals Mapped:**
SDG 4 – Quality Education
SDG 9: Industry, Innovation and Infrastructure
SDG 8: Decent Work and Economic Growth
SDG 11 – Sustainable Cities & Communities
SDG 16 – Peace, Justice & Strong Institutions

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

**Course Objectives:**

1. To discuss the need and process of digital forensics and Incident Response Methodology.
2. To explore the procedures for identification, preservation, and acquisition of digital evidence.
3. To explore techniques and tools used in digital forensics for Operating system and malware investigation
4. To explore techniques and tools used for Mobile forensics and browser, email forensics
5. To analyse legal and ethical considerations in the field of digital forensics and the handling Of digital evidence.
6. To evaluate the use of advanced digital forensics tools and techniques in cloud computing Environments and network forensics.

**Course Outcomes:**

1. Explain the phases of Digital Forensics and the methodology for handling computer security Incidents.
2. Demonstrate the process of collecting, analyzing, and recovering digital evidence.
3. Utilize various tools to analyses malware and acquired images of RAM/hard drives.
4. Apply digital forensic investigation techniques to mobile devices.
5. Evaluate the source and content authentication of emails and web browsers.
6. Generate clear and precise investigation reports that present valid conclusions.

| Module | Contents | Hours | COs |
|---|---|---|---|
| I | **Introduction to Digital Forensics** | 7 | CO1 |
| | Digital Forensics: Definition, Digital Forensics Goals, Digital Forensics Categories - Computer Forensics, Mobile Forensics, Network Forensics, Database Forensics Cyber crimes overview, Goals of Incident Response, CSIRT, Incident Response Methodology, Phase after detection of an incident,Forensic investigation lifecycle.<br><br>**Self-Learning Topics:** Incident - Computer Security Incident | | |
| II | **Digital Evidence, Forensics Duplication and Digital Evidence Acquisition** | 10 | CO2 |
| | Digital evidence, Types of Digital Evidence, Challenges in acquiring Digital evidence, Admissibility of evidence, Challenges in evidence handling, Chain of Custody.<br>Digital Forensics Examination Process - Seizure, Acquisition, Analysis, Reporting. Necessity of forensic duplication, Forensic Image formats, Forensic duplication techniques.<br>Acquiring Digital Evidence - Forensic Image File Format, Acquiring Volatile Memory (Live Acquisition), Acquiring Nonvolatile Memory (Static Acquisition), Hard Drive Imaging Risks and Chal- lenges, Network Acquisition<br><br>**Self-Learning Topics:** Challenges in Acquiring and Handling Digi- tal Evidence | | |
| III | **Forensics Investigation** | 5 | CO3 |
| | Analyzing Hard Drive Forensic Images, Analyzing RAM Forensic Image, Investigating Routers.<br>Malware Analysis - Malware, Viruses, Worms, Essential skills and tools for Malware Analysis, List of Malware Analysis Tools and Techniques<br><br>**Self-Learning Topics:** Cloud Forensics | | |
| IV | **Windows and Unix Forensics Investigation** | 9 | CO4 |
| | Investigating Windows Systems - File Recovery, Windows Recycle Bin Forensics, Data Carving, Windows Registry Analysis, USB De- vice Forensics, File Format Identification, Windows Features, Fo- rensics Analysis, Windows 10 Forensics, Cortana Forensics Investigating Unix Systems - Reviewing Pertinent Logs, Performing Keyword Searches, Reviewing Relevant Files, Identifying Unauthorized User Accounts or Groups, Identifying Rogue Processes, Checking for Unauthorized Access Points, Analyzing Trust Relationships<br>**Self-Learning Topics:** Encryption in Digital Forensics Investiga tions | | |
| V | **Mobile Forensics** | 9 | CO5 |
| | Android Forensics, Mobile Device Forensic Investigation – Storage location, Acquisition methods, Data Analysis | | |

| Module | Contents | Hours | COs |
|---|---|---|---|
| | GPS forensics - GPS Evidentiary data, GPS Exchange Format (GPX), GPX Files, Extraction of Waypoints and Track Points, Dis- play the Tracks on a Map.<br>SIM Cards Forensics - The Subscriber Identification Module (SIM), SIM Architecture, Security, Evidence Extraction.<br><br>**Self-Learning Topics:** Securing Mobile Devices for Forensic Inves tigations | | |
| **VI** | **Browser, Email Forensic & Forensic Investigation Reporting** | 5 | CO6 |
| | Web Browser Forensics, Google chrome, Other web browser investigation<br>Email forensics - Sender Policy Framework (SPF), Domain Key Identified Mail (DKIM), Domain based Message Authentication Re- porting and Confirmation (DMARC)<br>Investigative Report Template, Layout of an Investigative Report, Guidelines for Writing a Report<br><br>**Self-Learning Topics:** Impact of Privacy Features in Web Browsers on Forensic Investigations | | |
| | **Total** | **45** | |

**List of Experiments:**

| Sr. No. | Title of Experiment | COs Mapped |
|---|---|---|
| 1 | Analysis of forensic images using open source tools:<br>□ FTK Imager<br>□ Autopsy | CO1 |
| 2 | Explore forensics tools in kali linux for acquiring, analyzing and duplicating<br>data:<br>□ Dd<br>□ dcfldd | CO2 |
| 3 | Performing penetration testing using Metasploit - kali Linux. | CO1,2 |
| 4 | Performing RAM Forensic to analyze memory images to find traces of an attack.<br><br>□ Capturing RAM Using the DumpIt Tool<br><br>□ Volatility tool | CO2,3 |
| 5 | Network forensics using Network Miner. | CO1,2 |
| 6 | Windows Recycle Bin Forensics | CO2 |
| 7 | Data Carving using open source tools | CO2,4 |

| Sr. No. | Title of Experiment | COs Mapped |
|---|---|---|
| | □ Foremost<br>□ Scalpel<br>□ Jpegcarver | |
| 8 | USB Device Forensics using<br>□ USBDeview<br>□ USB Detective | CO2 |
| 9 | Web Browser Forensics using DB Browser for SQLite. | CO5 |
| 10 | Email Analysis | CO5,6 |

**Evaluation Scheme and Assessment:**

**A. Internal Assessment Examination:**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination:**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA): (If Applicable)**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any Other

**Note:** Number of activities to be conducted under TAE would be as per the subject need.

**D. Oral & Practical Exam: (If Applicable)**

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Bill Nelson, Amelia Phillips, and Christopher Steuart, Guide to Computer Forensics and Investigations, 5th Edition, Cengage Learning, 2018.r
2. Eoghan Casey, **Digital Evidence and Computer Crime**, 3rd Edition, Academic Press, 2011.
3. Harlan Carvey, **Windows Forensic Analysis Toolkit**, 4th Edition, Syngress, 2014.
4. Rohit Tamma and Donnie Tindall, **Learning Android Forensics**, 1st Edition, Packt Publishing, 2015
5. Darren R. Hayes, **Email Forensics: Web-based and Email Investigations**, 1st Edition, Pearson, 2020.

**Text Books:**

1. Kevin Mandia, Chris Prosise, "Incident Response and computer forensics", Tata McGrawHill, 2006

2. Digital Forensics Basics A Practical Guide Using Windows OS — Nihad A. Hassan, APress Publication, 2019.
3. Xiaodong Lin, "Introductory Computer Forensics: A Hands-on Practical Approach", Springer Nature, 2018.

**Useful Links:**

1. https://nptel.ac.in/courses/106/105/106105217/
2. https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
3. https://www.coursera.org/learn/incident-response
4. https://www.coursera.org/learn/ibm-penetration-testing-incident-response-forensics 5. https://www.coursera.org/learn/digital-forensics-essentials-df

| Course Title: Blockchain | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester: VII** | | | **Term: ODD** | | | | **Course Code:** 24CSPCC7032C | | | | | |
| **Teaching Scheme** | | | | | | | **Evaluation Scheme** | | | | | |
| **Contact Hrs.** | | | **Credit Allotted** | | | **Total Credit** | **IAE 1** | **IAE 2** | **ESE** | **CA** | **OR/PR** | **Total** |
| **Th** | **Tu** | **Pr** | **Th** | **Tu** | **Pr** | | | | | | | |
| 2 | - | 2 | 2 | - | 1 | 3 | 20 | 20 | 60 | 25 | - | 125 |

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

**Course Objectives:**

1.Understand blockchain platforms and its terminologies
2. Understand the use of cryptography required for blockchain.
3. Understand smart contracts, wallets, and consensus protocols.
4. Design and develop blockchain applications

**Course Outcomes:**

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

1. Explain blockchain concepts
2. Apply cryptographic hash required for blockchain.
3. Apply the concepts of smart contracts for an application.
4. Design a public blockchain using Ethereum.
5. Design a private blockchain using Hyperledger.
6. Use different types of tools for blockchain applications

| Module | Contents | Hours | COs |
|---|---|---|---|
| I | **Introduction to Blockchain** | 4 | CO1 |
| | What is a blockchain, Origin of blockchain (cryptographically se-cure hash functions), Foundation of blockchain: Merkle trees Components of blockchain, Block in blockchain, Types<br><br>**Self-Learning Topics:** Limitations and Challenges of blockchain, Introduction to Block-chain and Why Blockchain Is Important | | |
| II | **Cryptocurrency** | 5 | CO2 |
| | Cryptocurrency: Bitcoin, Altcoin, and Tokens (Utility and Security),Cryptocurrency wallets: Hot and cold wallets, Cryptocurrency usage, Transactions in Blockchain, UTXO and double spending problem,Bitcoin blockchain: Consensus in Bitcoin, Proof-of-Work (PoW), Proof-of-Burn (PoB), Proof-of-Stake (PoS), and Proof-of-Elapsed Time (PoET).<br><br>**Self-Learning Topics:** Life of a miner, Mining difficulty, Mining pool and its methods. | | |
| III | **Programming for Blockchain** | 6 | CO3 |
| | Introduction to Smart Contracts, Types of Smart Contracts, Structure of a Smart Contract, Smart Contract approach Limitations of Smart Contracts. Introduction to Programming: Solidity Programming Basics, functions, Visibility and Activity Qualifiers, Address and Address Payable, Bytes and Enums, Arrays-Fixed and Dynamic Arrays, Special Arrays-Bytes and strings, Struck, Mapping, Inheritance, Error handling.<br><br>**Self-Learning Topics:** Smart Contracts, Basics of Solidity Programming. | | |
| IV | **Public Blockchain** | 5 | CO4 |
| | Introduction to Public Blockchain, Ethereum and its Compo-nents, Mining in Ethereum, Ethereum Virtual Machine (EVM), Transaction, Accounts, Architecture and Workflow, Comparison between Bitcoin and Ethereum<br><br>**Self-Learning Topics:** Ethereum, Introductions of EVM | | |
| V | **Private Blockchain** | 5 | CO5 |
| | Introduction, Key characteristics, Need of Private Blockchain, Smart Contract in a Private Environment, State Machine Repli-cation, Consensus Algorithms for Private Blockchain - PAXOS and RAFT, Byzantine Faults: Byzantine Fault Tolerant (BFT) and Practical BFT Introduction to Hyper ledger, Tools and Frameworks Hyperledger | | |

| Module | Contents | Hours | COs |
|---|---|---|---|
| | Fabric, Comparison between Hyperledger Fabric & Other Technologies<br><br>**Self-Learning Topics:** Introduction of Private Blockchain and Fea-tures | | |
| **VI** | **Tools and Applications of Blockchain** | **5** | **CO6** |
| | Corda, Ripple, Quorum and other Emerging Blockchain Plat-forms, Blockchain in DeFi: Case Study on any of the Blockchain Plat-forms. Remix IDE,Ethereum<br><br>**Self-Learning topics**: Introduction to Solc, Truffle, Ganache, Metamask, Remix, Geth | | |
| | **Total** | **30** | |

**List of Experiments:**

| Sr. No. | Title of Experiment | COs Mapped |
|---|---|---|
| 1 | Cryptography in Blockchain, Merkle root tree hash. | CO1 |
| 2 | Embedding wallet and transaction using Solidity. | CO2 |
| 3 | Creating Transactions using Solidity and Remix IDE. | CO3 |
| 4 | Creating Smart Contract using Solidity and Remix IDE. | CO3 |
| 5 | Blockchain platform ethereum using Geth. | CO4 |
| 6 | Case Study on Hyperledger | CO5 |
| 7 | Case Study on Other Blockchain platforms. | CO5 |

**Evaluation Scheme and Assessment:**

A. **Internal Assessment Examination:**
Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

B. **End Semester Theory Examination:**
End Semester exam of 60 Marks will be conducted based on entire syllabus.

C. **Continuous Assessment (CA): (If Applicable)**
Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any Other

**Note:** Number of activities to be conducted under TAE would be as per the subject need.

**D. Oral & Practical Exam: (If Applicable)**

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

**Reference Books:**

1. Blockchain for Beginners, Yathish R and Tejaswini N, SPD
2. Blockchain Basics, A non Technical Introduction in 25 Steps, Daniel Drescher, Apress.
3. Blockchain with Hyperledger Fabric,Luc Desrosiers, Nitin Gaur, Salman A. Baset, Venkatraman Ramakrishna, Packt Publishing
4. Mastering Blockchain, Imran Bashir, Packt Publishing.
5. Blockchain Revolution: How the Technology Behind Bitcoin is Changing Money, Business and the World, Don Tapscott and Alex Tapscott, Penguin Random House.
6. The Basics of Bitcoins and Blockchains, Antony Lewis, Mango Publishing.

**Useful Links:**

1. MOOCs link (NPTEL, Udemy, Coursera, etc)

]

# Course Title: Virtual Reality

| Semester: VII | | | Term: ODD | | | | Course Code: 24CSPEC7041C | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| 03 | - | 02 | 03 | - | 01 | 04 | 20 | 20 | 60 | 25 | - | 125 |

Sustainable Development Goals Mapped:
SDG 4: Quality Education
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation and Infrastructure

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

**Course Objectives:**

1. To understand the need and significance of Virtual Reality.
2. To explore the concepts of Virtual reality and develop 3D virtual environments.
3. To understand the technical and engineering aspects of virtual reality systems.
4. To analyze various techniques for applying virtual reality.
5. To provide a foundation to the fast growing field of AR and make the students aware of the various AR devices.

**Course Outcomes:**

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

1. Explain fundamental concepts, components, and applications of Virtual Reality systems.
2. Apply geometric transformations and spatial representations in virtual environments.
3. Apply motion tracking and physical interaction concepts in VR systems.
4. Analyze VR applications and determine their suitability for real-world scenarios.
5. Evaluate augmented reality techniques including marker detection and tracking methods.
6. Evaluate AR systems, interfaces, and applications based on usability and technological requirements.

| Module | Contents | Hours | COs | RBT Level |
|---|---|---|---|---|
| I | **Introduction to Virtual Reality** | 06 | CO1 | L2 |
| | What is virtual reality? ,The beginnings of VR, VR paradigms, Collaboration, Virtual reality systems, Representation ,User interaction<br><br>**Self-learning:** Computer Graphics, Sensor Technologies | | | |
| II | **The Geometry of Virtual Worlds** | 07 | CO2 | L3 |
| | Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations<br><br>**Self-learning:** Content creation, Game Theory | | | |
| III | **Motion in Real and Virtual Worlds** | 09 | CO3 | L3 |
| | Velocities and Accelerations , The Vestibular System , Physics in the Virtual World , Mismatched Motion and Vection<br><br>**Self-learning:** Image Synthesis, Rendering, and Animation | | | |
| IV | **Applying Virtual Reality** | 08 | CO4 | L4 |
| | Virtual reality: the medium, Form and genre, What makes an application a good candidate for VR, Promising application fields, Demonstrated benefits of virtual reality , More recent trends in virtual reality application development, A framework for VR application development<br><br>**Self-learning:** Navigation and tracking in AR/VR | | | |
| V | **Augmented Reality** | 09 | CO5 | L5 |
| | Terminology, Simple augmented reality, Augmented reality as an emerging technology, Augmented reality applications, Marker detection, Marker pose, Marker types and identification: Template markers, 2D bar-code markers, Imperceptible markers: Image markers, Infrared markers, Miniature markers, Discussion on marker use, General marker detection application<br><br>**Self-learning:** Principles of scanning and 3D reconstruction | | | |
| VI | **AR Development & Applications** | 06 | CO6 | L5 |
| | User interfaces, Avoiding physical contacts , Practical experiences with head-mounted displays , Authoring and dynamic content ,AR applications and future visions, How to design an AR application ,Technology adoption and acceptance , Where to use augmented reality<br><br>**Self-Learning Topics:** Sensor data fusion, basic project | | | |

| Module | Contents | Hours | COs | RBT Level |
|---|---|---|---|---|
| | management skills<br>**Advanced topic:** Spatial Computing and Mixed Reality, Metaverse Architecture and Virtual Ecosystems | | | |
| | **Total** | **45** | | |

**List of Experiments:**

| Sr No. | List of Experiment | COs |
|---|---|---|
| **1** | Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same. | 1 |
| **2** | Demonstration of the working of HTC Vive, Google Cardboard, Google Daydream and Samsung gear VR. | 1 |
| **3** | Develop a scene in Unity that includes:<br>i. a cube, plane and sphere, apply transformations on the 3 game objects.<br>ii. add a video and audio source | 2 |
| **4** | Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the colour, material and texture of each Game object separately in the scene. Write a C# program in visual studio to change the colour and material/texture of the game objects dynamically on button click. | 2 |
| **5** | Develop a scene in Unity that includes a sphere and plane. Apply Rigid body component, material and Box collider to the game Objects. Write a C# program to grab and throw the sphere using the vr controller. | 3 |
| **6** | Develop a simple UI(User interface ) menu with images, canvas, sprites and buttons. Write a C# program to interact with UI menu through VR trigger button such that on each successful trigger interaction display a score on scene . | 3 |
| **7** | Place a three-dimensional ARCore pawn on detected AR plane surfaces | 4 |
| **8** | Using the Augmented Faces feature in your own apps. | 4 |

**Evaluation Scheme and Assessment:**

**A. Internal Assessment Examination:**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination:**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs / LOs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any Other

**Note:** Number of activities to be conducted under TAE would be as per the subject need.

**Reference Books:**

1. 1. AR Game Development‖, 1st Edition,Allan Fowler, A press Publications, 2018, ISBN 9781484236178
2. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
3. Learning Virtual Reality, Tony Parisi,O'Reilly Media, Inc., 2015, ISBN- 9781491922835

**Text Books:**

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)‖. Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig,WiLliam R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.
4. Theory and applications of marker-based augmented reality SanniSiltanen

**Useful Links:**

1. https://freevideolectures.com/course/3693/virtual-reality
2. https://www.vrlabacademy.com/
3. https://arvr.google.com/ar/
4. https://konterball.com/

| Course Title: Remote Sensing and GIS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester:** VII | | | **Term:** ODD | | | | **Course Code:** 24CSPCC7042C | | | | | |
| **Teaching Scheme** | | | | | | | **Evaluation Scheme** | | | | | |
| **Contact Hrs.** | | | **Credit Allotted** | | | **Total Credit** | **IAE 1** | **IAE 2** | **ESE** | **CA** | **Or/Pr/ Tut.** | **Total** |
| **Th** | **Tu** | **Pr** | **Th** | **Tu** | **Pr** | | | | | | | |
| 2 | - | 2 | 2 | - | 1 | 3 | 20 | 20 | 60 | 25 | - | 125 |

**Sustainable Development Goals Mapped:**

**Course Objectives:**

1. To understand fundamental principles of remote sensing and electromagnetic spectrum.
2. To introduce satellite systems, sensors, and data acquisition techniques.
3. To develop knowledge of GIS concepts, spatial data models, and coordinate systems.
4. To enable students to process and analyze spatial and remote sensing data.
5. To apply GIS and RS tools in solving real-world computing and engineering problems.
6. To familiarize students with modern geospatial technologies and software tools.

**Course Outcomes:**

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

1. Explain principles of remote sensing and EMR interactions.
2. Analyze satellite data and image interpretation techniques.
3. Understand GIS data models, coordinate systems, and database structures.
4. Perform spatial analysis and digital image processing.
5. Apply RS & GIS in real-world applications like urban planning, agriculture, etc.

Use GIS/RS software tools for data visualization and decision-making.

| Module | Content | Hours | COs | RBT Level |
|---|---|---|---|---|
| **I** | **Fundamentals of Remote Sensing** | | | |
| | Definition, components of remote sensing, Electromagnetic spectrum and radiation principles, Energy interaction with atmosphere and earth surface, Spectral signatures (soil, water, vegetation),<br><br>**Self Learning**: Platforms and types of sensors | 5 | 1 | L1 |
| **II** | **Remote Sensing Data & Image Interpretation** | | | |
| | Satellite systems (IRS, Landsat), Spatial, spectral, radiometric, temporal resolution, Image interpretation elements (tone, texture, pattern), Visual interpretation techniques.<br><br>**Self Learning:** Introduction digital image processing | 5 | 2 | L4 |
| **III** | **Digital Image Processing** | | | |
| | Image enhancement (contrast stretching, filtering), Image classification (supervised & unsupervised), Accuracy assessment,<br><br>**Self Learning:** Image rectification and geo-referencing | 5 | 3 | L1 |
| **IV** | **GIS Fundamentals** | | | |
| | Introduction to GIS and components, Spatial vs non-spatial data, Raster and vector data models, Map projections and coordinate systems,<br><br>**Self Learning:** GIS database concepts | 5 | 4 | L6 |
| **V** | **Spatial Analysis & GIS Modelling** | | | |
| | Data input and editing techniques, Overlay analysis, buffering, network analysis, Digital Elevation Model (DEM),<br><br>**Self Learning:** Spatial interpolation techniques | 5 | 5 | L3 |
| **VI** | **Applications of RS & GIS** | | | |
| | Urban planning and smart cities, Agriculture and precision farming, Disaster management, Environmental monitoring,<br><br>**Self Learning:** Integration with AI/ML and cloud GIS | 5 | 6 | L3 |
| **Total** | | **30** | | |

| Sr No. | List of Experiment | COs |
|---|---|---|
| 1 | Study of electromagnetic spectrum and spectral signatures | 1 |
| 2 | Identification of remote sensing platforms and sensors | 1 |
| 3 | Visual interpretation of satellite images | 2 |
| 4 | Analysis of resolution types using sample datasets | 2 |
| 5 | Creation of vector and raster datasets | 3 |
| 6 | Working with coordinate systems and projections | 3 |
| 7 | Image enhancement using GIS software (QGIS/ArcGIS) | 4 |
| 8 | Supervised and unsupervised classification | 4 |
| 9 | Land use/land cover mapping | 5 |
| 10 | Urban growth analysis using GIS | 5 |
| 11 | Geo-referencing and map creation | 6 |
| 12 | Spatial analysis (buffer, overlay, network analysis) | 6 |

**Evaluation and Assessment Scheme:**

**A. Internal Assessment Examination (IAE):**

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

**B. End Semester Theory Examination (ESE):**

End Semester exam of 60 Marks will be conducted based on entire syllabus.

**C. Continuous Assessment (CA):**

Continuous Assessment should consist of the following

**Experiments / Tutorials (8 to 10):** 10 marks (All COs should be covered)

**Attendance (Theory & Practical):** 05 marks

**Teacher Assessment Examination (TAE):** 10 Marks

**List of Teacher Assessment Examination (TAE):**

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flipped Classroom
8. Topic Review
9. Quiz
10. Mind Mapping

11. Any other.

**Note**: Number of activities to be conducted under TAE would be as per the subject need.

**Reference Books:**

**1.** Textbook of Remote Sensing and GIS, M. Anji Reddy
**2.** Geographic Information Systems: An Introduction, Tor Bernhardsen
**3.** Advanced Surveying (GIS & Remote Sensing) , Satheesh Gopi
**4.** Remote Sensing: Models and Methods, Robert A. Schowengerdt
**5.** Concepts and Techniques of GIS. Lo & Yeung
**6.** Introductory Digital Image Processing, Jensen

**Text Books:**

1. Remote Sensing and GIS, Basudeb Bhatta, Oxford University Press, (Latest Edition),
2. Introduction to Geographic Information Systems, Kang-tsung Chang, McGraw Hill
3. Remote Sensing and Image Interpretation, Thomas Lillesand, Ralph Kiefer, Jonathan Chipman Wiley
4. Remote Sensing of the Environment, John R. Jensen Pearson
5. Fundamentals of GIS, Michael N. Demers, Wiley
**6.** GIS Fundamentals: A First Text on Geographic Information Systems, Paul Bolstad Eider Press

**Useful Links:**

1. https://elearning.iirs.gov.in/#ncertCourses
2. https://onlinecourses.nptel.ac.in/noc22_ce26/preview
3. https://www.coursera.org/specializations/gis

## Course Title: Corporate Communication & Employability Skills – II (CCES) (EEP Communication)

| Semester: VII | | | Term: Odd | | | | Course Code: 24CSAEC701C | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | | | | | Evaluation Scheme | | | | | |
| Contact Hrs. | | | Credit Allotted | | | Total Credit | IAE 1 | IAE 2 | ESE | CA | OR/PR | Total |
| Th | Tu | Pr | Th | Tu | Pr | | | | | | | |
| -- | -- | 02 | -- | -- | 01 | 01 | -- | -- | -- | 25 | -- | 25 |

IAE: Internal Assessment Examination ESE:
End Semester Examination
CA: Continuous Assessment

## Course Objectives:

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

1. Apply required interpersonal skills so as to face challenges at the global level.
2. Equip students with relevant employment skills for their career advancement.

## Course Outcomes:

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

1. Exhibit emotional intelligence by recognizing and responding appropriately to the emotions and perspectives of individuals from various cultural backgrounds.
2. Develop a comprehensive set of employability skills, including critical thinking, problem-solving, and adaptability, to navigate the evolving job market.

| Tut No. | List of Tutorials | Hours | COs |
|---|---|---|---|
| | **Listening Skills** | | |
| 1 | IELTS Listening | **1** | **1** |
| 2 | Grooming, Dress and Appearance | **1** | **1** |
| | **Speaking Skills** | | |
| 3 | Self-Introduction | **1** | **1** |
| 4 | Technical Presentation (External Evaluator) | **1** | **1** |
| 5 | Impromptu Speech | **1** | **1** |
| 6 | Group Discussion | **1** | **2** |
| 7 | Mock Interview (Panel/Online) | **2** | **2** |
| | **Reading Skills** | | |
| 8 | Book Review | **2** | **2** |
| 9 | Crossword & News/Editorial Reading | **1** | **2** |
| | **Writing Skills** | | |
| 10 | Proficiency Test | **1** | **2** |
| 11 | Resume Writing | **1** | **2** |
| 12 | Official Correspondence: Inquiry & Reply, Complaint & Adjustment | **1** | **2** |
| | **Total** | **14** | |

**Evaluation and Assessment Scheme:**

**Assessment**

**Examination Scheme: Total Marks**

**25 Continuous Assessment: 25**

**Marks**

Assignment + Attendance= 5 + 5=10 Marks
Technical Presentation = 05 Marks

Group Discussion + Mock Interview =05 + 05 = 10 Marks

Assessment: There is internal assessment only

**Reference Books:**

1. M Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hill, 2008
2. Gadyalji Vaishali K, Communication Skills, Nandu Publications, 2010
3. Rai Urmila & Rai S.M, Business Communication, Himalaya Publishing House, 2007
4. Rai Urmila & Rai S.M, Business Communication, Himalaya Publishing House, 2008
5. Raman Meenakshi & Sharma Sangeeta, Technical Communication Principles and Practice, Ox- ford University Press, 2015
6. Raman Meenakshi & Singh Prakash, Business Communication, Oxford University Press, 2008
7. Locker O Kitty & Kaczmarek Kyo Stephen, Business Communication Building Critical Skills, McGraw Hill Education Private Limited, 2007
8. Chaturvedi P D & Chaturvedi Mukesh, Business Communication Concepts, Cases and Appli- cations, Pearson Education, 2008

**Text Books:**

1. Luthans Fred, Organizational Behavior An Evidence-Based Approach, McGraw Hill Education Private Limited, 2013

**Useful Links:**

1. https://youtu.be/k9NMWDqun5A?si=HKOdK5PtKy6HvkBk
2. https://youtu.be/waOIjlaTSo8?si=iHiCOT-KQRoJvFE3
3. https://youtu.be/FfhZFRvmaVY?si=7NcRYuRBb0F6sfKf
4. https://youtu.be/FVqSiFUVX78?si=-ZMO0_yT-Hl-5UW0
5. https://youtu.be/6OdCoMgpx7o?si=iq2oK3auNRI1Z7D0