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 Science & Engineering (Data Science)

Second Year
Semester – III

SJCEM : R–25

Effective from Academic Year 2026-27

Program Structure for Second Year Computer Science and Engineering (Data Science)

(With Effect from 2026-2027)

Semester III

Course Code	Vertical	Course Name	Contact Hrs			Credit Allotted			Total Credits
			Th	Tut	Pr	Th	Tut	Pr	
25CSDSPCC301	PCC	Discrete Mathematics	3	1	-	3	1	-	4
25CSDSPCC302	PCC	Data Structures	3	-	2	3	-	1	4
25CSDSPCC303	PCC	Microprocessor and Computer Architecture	3	-	2	3	-	1	4
25CSDSPCC304	PCC	Database Management System	3	-	2	3	-	1	4
25CSDSPCC305	PCC	Programming Language I: (Python)	1	-	2	1	-	1	2
25CSDSVEC301	VEC	Universal Human Values	2	1	-	2	1	-	3
25CSDSAEC301	AEC	Employability Enhancement Program – I (Communication)	-	1	-	-	1	-	1
		Total	**15**	**3**	**8**	**15**	**3**	**4**	**22**

Course Code	Vertical	Course Name	Evaluation Scheme					
			IAE 1	IAE 2	ESE	CA	OR/ PR	Total
25CSDSPCC301	PCC	Discrete Mathematics	20	20	60	25	-	125
25CSDSPCC302	PCC	Data Structures	20	20	60	25	25	150
25CSDSPCC303	PCC	Microprocessor & Computer Architecture	20	20	60	25	-	125
25CSDSPCC304	PCC	Database Management System	20	20	60	25	25	150
25CSDSPCC305	PCC	Programming LanguageI (Python)	10	10	30	50	25	125
25CSDSVEC301	VEC	Universal Human Values	10	10	30	25	-	75
25CSDSAEC301	AEC	Employability Enhancement Program – I (Communication)	-	-	-	25	-	25
		Total	**100**	**100**	**300**	**200**	**75**	**775**

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Syllabus

for

Second Year

Computer Science & Engineering (Data Science)

Semester – III

SJCEM : R–25

(With Effect from 2026-27)

Course Title: Discrete Mathematics												
Semester: III			Term: ODD				Course Code: 25CSDSPCC301					
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:

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 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** Propositional Logic, Predicate Logic, Laws of Logic, Duality, Quantifiers, Binary Predicates, Mathematical Induction. **Self-learning Topics:** Normal Forms, Inference Theory of Predicate Calculus	7	CO1
II	**Relations and Functions** Basic concepts of Set Theory, **Relations:** Definition, Types of Relations, Representation of Relations, Closures of Relations, Warshall's algorithm, Equivalence relations and Equivalence Classes. **Functions:** Definition, Types of functions, Composition of functions, Identity and Inverse function **Self-learning Topics:** Operations on Relations- complementary relation, Inverse relation, Intersection and Union	8	CO2
III	**Posets and Lattice** Partial Order Relations, Poset, Supremum and Infimum, Hasse Diagram, Lattice, Types of Lattice- Sub -lattice, Distributive lattice. **Self-learning Topics:** Dual of Poset, Dual in a Lattice, Bounded lattice, Complemented lattice	8	CO3
IV	**Linear Algebra-I** Vector Arithmetic, Norm, Euclidean Inner Product, Unit vector, Angle between two vectors, Cauchy-Schwarz Inequality, Orthogonality, Orthogonal Set, Orthonormal set, Gram-Schmidt Process **Self-learning Topics:** Orthogonal Projection	7	CO4
V	**Linear Algebra-II** 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 **Self-learning Topics:** Derogatory and non-derogatory matrices, Functions of Square Matrix, Linear Transformations, Quadratic forms.	8	CO5

VI	**Fourier Series** 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. **Self-learning Topics:** Parseval's Identity, Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.	7	CO6
	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. 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,

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: 25CSDSPCC302					
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. Apply linear and non-linear data structures to solve computational problems.
2. Design solutions using stacks and queues for programming applications.
3. Implement linked list structures for efficient data management.
4. Apply tree operations and traversals in problem-solving scenarios.
5. Implement graph operations and traversals for real-world applications.
6. Select and apply appropriate searching and sorting techniques for application development.

Module	Contents	Hours	Cos
I	**Introduction to Data Structures:** Concept of ADT, Types of Data Structures- Linear and Nonlinear, Operations on Data Structures. Arrays, Multidimensional Arrays, Array of Pointers, String Manipulation. **Self-Learning:** Structures with pointers	5	CO1
II	**Stack and Queues:** **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. **Self-learning:** Implementation of stack and queue using structure	9	CO2
III	**Linked List:** 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, **Self-Learning:** Singly Linked List Application-Polynomial Representation and Addition.	9	CO3
IV	**Trees:** 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. **Self-Learning:** Red-Black trees	9	CO4
V	**Graphs:** Introduction, Graph Terminologies, Representation of Graph, Graph Traversals - Depth First Search (DFS) and Breadth First Search (BFS), **Self-Learning:** Graph Application- Topological Sorting.	5	CO5

VI	**Sorting and Searching Techniques:** Sorting Techniques: Bubble sort, insertion sort, selection sort Searching Techniques: Linear Search, Binary Search Hashing-Concept, Hash Functions, Collision resolution Techniques **Self-Learning:** Merge sort and quick sort.	8	CO6
	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: 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. E. 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*, 2nd Edition, CENGAGE Learning.
4. ISRD Group, *Data Structures Using C*, 2nd Edition, 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: 25CSDSPCC303					
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.
6. To prepare students for learning various threading technologies.

Course Outcomes:

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

1. Explain the organization of a computer system and develop assembly language programs using the 8086 microprocessor.
2. Analyze control unit design techniques and instruction-level parallelism concepts.
3. Apply the core concepts and programming features of the 8086 microprocessor.
4. Identify and evaluate the specifications of peripheral interfacing chips.
5. Design 8086-based systems using memory and peripheral devices.
6. Explain advanced processor architectures and hyper-threading technology.

Module	Contents	Hours	COs
I	**Overview of Computer architecture and Organization** Introduction of Computer Organization and Architecture, Von Neumann Model, Performance Measure of Computer Architecture. Architecture of 8086 Family, Instruction Set, Addressing Modes. **Self-learning Topics:** Basic Organization of Computer and Block Level Description of the Functional Units, Evolution of Computers	5	CO1
II	**Processor organization and architecture** CPU Architecture, Instruction Formats, Basic Instruction Cycle with Interrupt Processing. 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. **Self-learning Topics:** Instruction Interpretation and Sequencing, Concepts of Nano Programming.	7	CO2
III	**The Intel microprocessors 8086 architecture** 8086CPU Architecture, Programmer's Model, Functional Pin Diagram. Memory Segmentation, Banking in 8086, Functioning of 8086 in Minimum mode and Maximum mode. Timing diagrams for Read and Write operations in minimum and maximum mode. **Self-learning Topics:** De-multiplexing of Address/Data bus, Interrupt structure and its servicing.	8	CO3
IV	**Memory and peripherals Interfacing** Memory Interfacing - RAM and ROM Decoding, 8255-PPI-Block diagram, CWR, operating modes, interfacing with 8086. 8257-DMAC-Block diagram, DMA operations and transfer modes. Programmable Interrupt Controller 8259-Block Diagram. **Self-learning Topics:** Techniques Partial and Absolute, Interfacing the 8259 in single and cascaded mode.	10	CO4

V	**80386Dx processor and Pentium processor** Architecture of 80386 microprocessor. 80386 registers-General purpose Registers, EFLAGS and Control registers. Real mode, Protected mode, virtual 8086 mode. Pentium Architecture, Superscalar Operation, Integer &Floating-Point. Pipeline Stages, Branch Prediction Logic. **Self-learning Topics:** 80386 memory management in Protected Mode Descriptors and selectors, descriptor tables, the memory paging mechanism, Cache Organization and MESI protocol.	10	CO5
VI	**Pentium 4 and ARM processor** Comparative study of 8086, 80386, Pentium 1, Pentium II and Pentium. Pentium 4: Net burst micro architecture. Instruction translation look aside buffer and branch prediction, Hyper threading technology and its use in Pentium 4, Recap of modules, Outcomes, Applications and summarization. **Self-learning Topics:** Application and Features of ARM processors**.**	5	CO6
	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.
3. James Antonakos, *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 and 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/
   https://www.mooc-list.com/tags/microprocessors

Course Title: Database Management System												
Semester: III			Term: ODD				Course Code: 25CSDSPCC304					
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 learn the basics and understand the need of database management system.
2. To construct conceptual data model for real world applications
3. To Build Relational Model from ER
4. To introduce the concept of SQL to store and retrieve data efficiently Using Query Optimization Techniques.
5. To demonstrate notions of normalization for database design.
6. To understand the concepts of transaction processing- concurrency control & recovery procedures.

Course Outcomes:

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

1. Design ER models for real-world database applications.
2. Apply relational algebra operations to formulate database queries.
3. Construct SQL queries using DDL, DML, and DCL commands.
4. Apply normalization techniques for relational database design.
5. Analyze query processing, transaction management, concurrency, and recovery mechanisms.
6. Perform database operations using IBM Db2 and explore related certification opportunities.

Module	Contents	Hours	Cos
I	**Module 1: Database System Architecture and Entity Relationship Model** Database Management System Architecture , Data Abstraction and Data Independence , Entity Relationship Model : Entity Types , Entity Sets , Attributes and Keys , Relationship Types , Relationship Sets. Converting Entity Relational Model to Tables (Relational Database). **Self-Learning**: Object Relational Database Management System (ORDBMS).	8	CO1
II	**Module 2: Relational Algebra** Selection Operation, Projection Operation, Union Operation, Intersection Operation, Cartesian Operation and Join Operation. **Self-Learning**: Relational Calculus.	8	CO
III	**Module 3: Structured Query Language (SQL)** SQL Standards, Data Definition Commands, Set operations, aggregate function, null values, Data Manipulation commands, Data Control commands, Complex Retrieval Queries using Group By, Recursive Queries, and nested Queries. **Self-Learning**: Triggers, Procedures, Functions and Packages. Embedded SQL.	8	CO3
IV	**Module 4: Relational Database Design** 1NF, 2NF, 3NF, BCNF, Algorithm for Decomposition Using functional Dependencies, Decomposition Using Multivalued Attribute. **Self-Learning**: NoSQL Data Models.	8	**CO4**
V	**Module 5: Query Optimization and Transaction Concurrency Control** Query Optimization: Transformation Of Relational Expression, Estimating Statistics Of Expression Result, Choice Of Evaluation Plan. Transaction Concept, ACID Properties, Serializability, Lock Based Protocols, Multiple Granularity, Insertion-Deletion and Predicate Reads, Timestamp Based Protocols, Validation Base Protocols, Log Based Recovery **Self-Learning** : Distributed Transactions and TCL , Performance Tuning	9	**CO5**

VI	**Module 6: Foundations of IBM Db2** **IBM Db2 Overview** Introduction, Features, Editions, Industry Use Cases, Comparison with Other RDBMS, Db2 Installation and Interface System Requirements, Installation, CLP, IBM Data Studio, Db2 Web Console, Basic SQL Operations in Db2 CREATE, INSERT, UPDATE, DELETE, SELECT, Constraints, NULL Handling, Joins **Self-Learning:**. Db2 on Cloud, Backup & Recovery, Indexing & Performance Tuning, Distributed Databases, Db2 Warehouse on Cloud	4	**CO6**
	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, Silberchatz, 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: 25CSDSPCC305					
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 functions 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:** Introduction, Basic & Built-in Math functions, Basic data types (Numeric, Boolean, Compound), Quotes, print() function, range() function, Tuples, Lists, Dictionaries, Sets, Numpy Arrays, Strings. **Self-learning Topics:** Practical applications with combined data types.	3	CO1
II	**Control Statements and Function:** 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 (Lambda, Map, Reduce, Filter). **Self-learning Topics:** Zip() function, Function decorators.	3	CO2
III	**Object Oriented Programming:** Creating Classes and Objects, Self-Variable, Constructors, Inheritance, Polymorphism. **Self-learning Topics:** Exceptions Handling, User Defined Exceptions.	3	CO3
IV	**Modules and Packages:** Importing own module as well as external modules, Understanding Packages, modules and external packages, Opening and Reading Files and Folders (Python OS Module, Python Datetime Module, Python Math and Random Modules). **Self-learning Topics:** Regular expression in python, Text Processing.	2	CO4

V	**GUI Programming with Database Connectivity:** GUI Programming Toolkits, Creating GUI Widgets with Tkinter, Creating Layouts, Form Components, Dialog Boxes. Types of Databases used with Python, Mysql database Connectivity with Python, Performing DML operations on database. **Self-learning Topics:** File handling, Pickle in Python.	2	CO5
VI	**Advanced Python:** Emails with Python: Introduction to Emails with Python, Sending Emails with Python, Receiving Emails with Python. **Self-learning Topics:** Networking in Python: Client Server socket programming.	2	CO6
	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
M. T. Savaliya , R. K. Maurya, "Programming through Python", StarEdu Solutions.
2. 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: 25CSDSVEC301**					
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 gain clarity about the basic human aspirations of happiness and prosperity, and understand the role of right understanding, human relationships, and physical facilities in fulfilling them.
3. To become more responsible in life, especially in addressing day-to-day challenges by seeking sustainable and human-centered solutions.
4. To recognize and reflect on their role in human relationships, and respond with sensitivity, trust, and mutual respect in their personal and social life.
5. To become sensitive to their commitment towards what they have understood, including universal human values, harmony in relationships, and contribution to a just and humane society.
6. To apply the understanding of values and harmony in real-life situations within the self, family, society, and nature, thus making a conscious beginning towards value-based living.

Course Outcomes:

At the end of the course students will be able:

1. Explain the interdependence between Values and Skills in ensuring sustained happiness and prosperity, which are the core aspirations of all human beings.
2. Develop a holistic perspective among students towards life and profession through a correct understanding of human reality as the coexistence of self and body.
3. Understand the foundational values of trust and respect in human relationships and their role in achieving happiness and prosperity in family and society.
4. Apply the understanding of harmony and co-existence in nature to develop a holistic perception of existence.
5. Demonstrate ethical human conduct and natural acceptance of human values based on holistic understanding.

6 . Demonstrate trust and mutually fulfilling human behaviour, and mutually enriching interaction with nature and profession based on a value-based approach.

Module	Contents	Hours	Cos
I	**Introduction to Value Education** • Understanding Value Education • Self-exploration as the Process for Value Education- Continuous Happiness and Prosperity the Basic Human Aspirations • Right Understanding, Relationship and Physical Facility Happiness and Prosperity Current Scenario • Method to Fulfil the Basic Human Aspirations	**6**	CO 1
II	**Harmony in the Human Being** • Understanding Human being as the Co-existence of the Self and the Body • Distinguishing between the Needs of the Self and the Body The Body as an Instrument of the Self • Understanding Harmony in the Self • Harmony of the Self with the Body • Programme to Ensure self-regulation and Health	**6**	CO1
III	**Harmony in the Family and Society** • Harmony in the Family the Basic Unit of Human Interaction Values in Human-to-Human Relationship • 'Trust' – the Foundational Value in Relationship 'Respect' as the Right Evaluation Understanding Harmony in the Society • Vision for the Universal Human Order	**6**	CO2
IV	**Harmony in the Nature (Existence)** • Understanding Harmony in the Nature Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature • Realizing Existence as Co-existence at All Levels • The Holistic Perception of Harmony in Existence	**5**	CO2
V	**Implications of the Holistic Understanding** • Natural access acceptance of Human Values Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, • Humanistic Constitution and Universal Human Order	**4**	CO3

VI	**Professional Ethics** • Competence in Professional Ethics • Holistic Technologies, Production Systems and Management Models-Typical Case Studies • Strategies for Transition towards Value-based Life and Profession	**3**	CO3
	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: 25CSDSAEC301					
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							
--	01	--	--	01	--	01	--	--	--	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

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NAAC Accredited with Grade 'A+', Three Programs NBA Accredited

Bachelor of Technology

In

Computer Science & Engineering

(Data Science)

Third Year

Semester – V

SJCEM : R–24C

Effective from Academic Year 2026-27

Program Structure for Third Year Computer Science and Engineering

(Data Science)

(With Effect from 2026-2027)

Semester V

SCHEME: SJCEMR–24 Scheme C

Course Code	Vertical	Course Name	Contact Hrs			Credit Allotted			Total Credits
			Th	Tut	Pr	Th	Tut	Pr	
24CSDSPCC501C	PCC	Fundamentals of Data Science	3	-	2	3	-	1	4
24CSDSPCC502C	PCC	Artificial Intelligence	2	-	2	2	-	1	3
24CSDSPEC501XC	PEC	Program Elective - I	3	-	2	3	-	1	4
24CSDSPEC502XC	PEC	Program Elective - II	3	-	-	3	-	-	3
24MDM501XC	MDM	Multidisciplinary Minor	3	-	2	3	-	1	4
24OE501XC	OE	Open Elective I	3	-	-	3	-	-	3
24CSDSVSE501C	VSEC	Employability Enhancement Program -IV (Data Security lab)	-	-	2	-	-	1	1
Total			**17**	**0**	**10**	**17**	**0**	**5**	**22**

Course Code	Vertical	Course Name	Evaluation Scheme					
			IAE 1	IAE 2	ESE	CA	OR/PR	Total
24CSDSPCC501C	PCC	Fundamentals of Data Science	20	20	60	25	25	150
24CSDSPCC502C	PCC	Artificial Intelligence	20	20	60	25	-	125
24CSDSPEC501XC	PEC	Program Elective - I	20	20	60	25	25	150
24CSDSPEC502XC	PEC	Program Elective - II	20	20	60	-	-	100
24MDM501XC	MDM	Multidisciplinary Minor	20	20	60	25	-	125
24OE501XC	OE	Open Elective I	20	20	60	-	-	100
24CSDSVSE501C	VSEC	Employability Enhancement Program -IV (Data Security lab)	-	-	-	25	-	25
Total			**120**	**120**	**360**	**125**	**50**	**775**

Program Electives Courses

Program Electives Courses (PEC)				
	PEC 1		PEC 2	
Semester	**Track 1– DevOps and Cloud Computing**	**Track 2 – Soft and Quantum Computing**	**Track 3– Cyber Security and Ethical Hacking**	**Track 4 – Business Intelligence Developer**
Sem V	Software Engineering and Project Management	Advance Operating System	Cryptography & System Security	Advanced DBMS and SQL for Business Intelligence
Sem VI	DeVops Core Technologies	Distributed and Parallel Computing	Information Security	Data Warehousing and Mining
Sem VII	Cloud Computing	Soft Computing	Intrusion Detection Systems (IDS)	Knowledge Management and Business Intelligence
Sem VII	Cloud Security	Quantum Computing	Ethical Hacking & Penetration Testing	Business Intelligence tools and applications

Semester	**Program Elective I**			
	Track 01		**Track 02**	
	DevOps and Cloud Computing		**Soft and Quantum Computing**	
Sem V	24CSDSPEC5011C	Software Engineering and Project Management	24CSDSPEC5012C	Advance Operating System

Semester	**Program Elective II**			
	Track 03		**Track 04**	
	Cyber Security and Ethical Hacking		**Business Intelligence Developer**	
Sem V	24CSDSPEC5021C	Cryptography & System Security	24CSDSPEC5022C	Advanced DBMS and SQL for Business Intelligence

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	24OE50131C	Foreign Language I - Japanese	24OE5014C	Basics of Marketing Management
	24OE50132C	Foreign Language I – German		

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Syllabus

for

Third Year

Computer Science & Engineering (Data Science)

Semester – V

SJCEM : R–24C

(With Effect from 2026-27)

Course Title: Fundamentals of Data Science												
Semester: V			**Term: Odd**				**Course Code: 24CSDSPCC501C**					
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**	**25**	**150**
Sustainable Development Goals Mapped: 4, 8, 9, 11, 16, 17												

IAE: Internal Assessment Examination

ESE: End Semester Examination

CA: Continuous Assessment

Course Objectives:

1. Understand the fundamental concepts of Data Science, Big Data, and diverse data types.
2. Apply the Data Science Process for data acquisition, preparation, and exploration.
3. Explain the principles of learning from data for analytical problem solving.
4. Analyze techniques for handling and processing large datasets.
5. Examine fundamental text analytics methods for extracting insights from textual data.
6. Utilize visualization techniques to effectively communicate analytical findings.

Course Outcomes:

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

1. Identify data types, data sources, and applications of Data Science in real-world domains.
2. Perform data collection, cleaning, transformation, and exploratory analysis using the Data Science Process.
3. Explain supervised, unsupervised, and semi-supervised learning paradigms for data-driven applications.
4. Apply appropriate tools and techniques for analyzing large datasets and case studies.
5. Analyze textual data using fundamental text mining and text analytics techniques.
6. Develop visualizations and dashboards to communicate data-driven insights effectively.

Module	Content	Hours	COs	RBT Level
I	**Data Science Concepts and Data Types** Introduction to Data Science and Big Data, applications of data science in various domains, data-driven decision making, data lifecycle, characteristics of Big Data, types of data, structured and unstructured data, natural language data, machine-generated data, graph and network data, multimedia data (audio, image, and video), streaming data, data sources, challenges in handling different data types, and real-world examples of data science applications. **Self-Learning:** Open Data Repositories and Public Datasets for Data Science.	8	1	L2
II	**Data Science Process and Data Preparation** Overview of the Data Science Process, defining research goals and objectives, problem formulation, project planning, data collection and retrieval, data quality assessment, data cleaning and preprocessing, handling missing values and inconsistencies, data integration, data transformation, exploratory data analysis, basic statistical measures, data visualization techniques, pattern identification, and preparation of datasets for analysis. **Self-Learning Topic:** Data Cleaning Techniques Using Spreadsheet and Python Tools.	7	2	L3
III	**Introduction to Learning from Data** Concept of learning from data, applications in data science, overview of predictive analytics, role of learning techniques in the data science workflow, introduction to Python-based analytical tools, feature selection concepts, training and testing datasets, model validation concepts, prediction of new observations, fundamentals of supervised learning, fundamentals of unsupervised learning, semi-supervised learning, and simple real-world examples of classification and clustering. **Self-Learning Topic:** Exploring Beginner-Friendly Machine Learning Applications.	8	3	L2
IV	**Data Handling and Analytical Case Studies** Challenges in handling large datasets, efficient data storage and processing techniques, selecting suitable algorithms and data structures, analytical tool selection, programming practices for data analysis, efficient use of computing resources, introduction to predictive analytics through case studies, recommender system	8	4	L4

	concepts, and application of the data science process to real-world problems. **Self-Learning Topic:** Introduction to Cloud-Based Data Analytics Platforms.			
V	**Text Analytics Fundamentals** Introduction to text mining and text analytics, applications of text analytics, text preprocessing, tokenization, bag-of-words representation, stemming and lemmatization, basic text classification concepts, introduction to Natural Language Processing tools, analysis of textual datasets, and application of the data science process to text data. **Self-Learning Topic:** Chatbots and Conversational AI: A Basic Overview.	7	5	L4
VI	**Data Visualization and Communication** Importance of data visualization, principles of effective visual communication, common visualization techniques, charts and graphs for data analysis, exploratory and explanatory visualization, interactive data visualization concepts, dashboard fundamentals, dashboard development tools, presentation of analytical findings, storytelling with data, and communicating insights to decision-makers. **Self-Learning Topic:** Business Intelligence Dashboards and Data Storytelling.	7	6	L3
Total		**45**		

Sr No.	List of Experiment	COs
1.	Data Collection and Dataset Exploration using Public Datasets	CO1
2.	Data Types and Data Structures using Python and Pandas	CO1
3.	Data Cleaning and Preprocessing of Real-World Datasets	CO2
4.	Data Transformation and Feature Engineering Techniques	CO2
5.	Exploratory Data Analysis (EDA) using Statistical Measures	CO2

6.	Correlation Analysis and Pattern Identification in Datasets	CO2
7.	Implementation of a Simple Classification Problem	CO3
8.	Implementation of a Simple Clustering Problem	CO3
9.	Text Data Preprocessing: Tokenization, Stemming, and Lemmatization	CO5
10.	Text Analytics using Bag-of-Words and Word Frequency Analysis	CO5
11.	Data Visualization using Charts, Graphs, and Plots	CO6
12.	Development of an Interactive Dashboard for Data Visualization	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 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. An Introduction to Statistical Learning with Applications in Python, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani and Jonathan Taylor
2. Introduction to Data Mining: 2nd Edition, Pang-Ning Tan, Michael Steinbach, Anuj Karpatne and Vipin Kumar
3. Fundamentals of Data Visualization, Claus O. Wilke

Text Books:

1. Data Science for Business, Foster Provost and Tom Fawcett
2. Doing Data Science: Straight Talk from the Frontline, Cathy O'Neil and Rachel Schutt
3. Data Science from Scratch: 2nd Edition, Joel Grus
4. Practical Statistics for Data Scientists: 2nd Edition, Peter Bruce, Andrew Bruce and Peter Gedeck
5. Python for Data Analysis: 3rd Edition, Wes McKinney

Useful Links:

1. **Data Science Methodology**, Coursera
   https://www.coursera.org/learn/data-science-methodology
2. **Data Science A-Z: Hands-On Exercises & ChatGPT Prize [2026]**, Udemy
   https://www.udemy.com/course/datascience
3. **Python for Data Science and Machine Learning Bootcamp**, Udemy
   https://www.udemy.com/course/python-for-data-science-and-machine-learning-bootcamp
4. **Data Science for Beginners**, Microsoft Learn
   https://learn.microsoft.com/en-us/training/paths/data-science
5. **Introduction to Data Science**, edX
   https://www.edx.org/learn/data-science
6. **Data Analysis with Python**, freeCodeCamp
   https://www.freecodecamp.org/learn/data-analysis-with-python

Course Title: Artificial Intelligence												
Semester: V			**Term: Odd**				**Course Code: 24CSDSPCC502C**					
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: 4, 8, 9, 11, 16, 17												

IAE: Internal Assessment Examination

ESE: End Semester Examination

CA: Continuous Assessment

Course Objectives:

1. Understand the foundations, concepts, and applications of Artificial Intelligence.
2. Analyze intelligent agents, agent architectures, and environment characteristics.
3. Apply AI-based problem-solving and search techniques.
4. Apply knowledge representation, reasoning, perception, and learning concepts.
5. Examine probabilistic reasoning techniques for decision making under uncertainty.
6. Evaluate the capabilities, limitations, and societal implications of intelligent systems.

Course Outcomes:

After successful completion of the course students will be able to:

1. Analyze the characteristics of environments and differentiate various intelligent agent architectures.
2. Apply appropriate search techniques to design AI-based problem-solving agents.
3. Represent knowledge using logical formalisms and apply inference mechanisms to develop knowledge-based agents.
4. Apply probabilistic reasoning techniques for decision making under uncertainty.
5. Explain fundamental learning paradigms and techniques used in intelligent systems.
6. Design the essential components of an expert system for real-world applications.

Module	Contents	Hours	COs	RBT Level
I	**Introduction to Artificial Intelligence** Fundamentals of Artificial Intelligence and its significance, AI perspectives including acting humanly, thinking humanly, acting rationally, and thinking rationally, evolution and milestones in AI development. Applications of AI across various domains, current trends and state of AI, opportunities and challenges in AI adoption, and ethical, social, and responsible AI considerations. **Self-learning Topics:** Ethical Frameworks, Continuous Learning Human-in-the-Loop Approaches	5	CO1	L2
II	**Intelligent Agents** Introduction of agents, Structure of Intelligent Agent, Characteristics of Intelligent Agents. Types of Agents: Simple Reflex, Model Based, Goal Based, Utility Based Agent. Environment Types: Deterministic, Stochastic, Static, Dynamic, Observable, Semi-observable, Single Agent, Multi Agent. Performance Measure, Environment, Actuators and Sensors (PEAS) Framework for Intelligent Agents **Self-learning Topics:** Genetic Representation of Agents, Fitness Evaluation	5	CO2	L3
III	**Solving Problems by Searching** AI Problem Solving and Search Strategy Evaluation. Uninformed search techniques: Breadth First Search, Depth First Search, Uniform Cost Search and Iterative Deepening Search, heuristic functions and admissible heuristics, Informed search techniques: Greedy Best First Search and A* Search. Local search using Hill Climbing, game playing and adversarial search, Mini-Max algorithm, and Alpha-Beta pruning. **Self-learning Topics:** Metaheuristic Algorithms for Problem Solving	5	CO3	L3
IV	**Knowledge Representation and Reasoning** Introduction to knowledge and knowledge representation, issues and properties of knowledge representation systems, propositional logic including syntax, semantics, logical connectives and truth tables, predicate logic fundamentals, quantifiers and inference rules, reasoning using forward chaining and backward chaining, and introduction to logic programming using PROLOG.	5	CO4	L3

	Self-Learning Topic: Advanced applications of Propositional and First-Order Predicate Logic in intelligent systems.			
V	**Reasoning Under Uncertainty** Fundamentals of uncertainty in Artificial Intelligence, representation and handling of uncertain knowledge, random variables and probability concepts, prior and posterior probabilities, probabilistic inference using joint probability distributions, Bayes' theorem and its applications, Bayesian belief networks, construction of belief networks, and reasoning under uncertainty using probabilistic models. **Self-learning Topics:** Bayesian Optimization	5	CO5	L4
VI	**Learning, Planning and Expert Systems** Introduction to AI planning and planning problems, learning in Artificial Intelligence, learning agents, concepts of supervised, unsupervised, semi-supervised and reinforcement learning, overview of expert systems, components of expert systems including knowledge base, inference engine, working memory and user interface, knowledge acquisition, and applications of expert systems in real-world domains. **Self-Learning Topic:** Transfer Learning, Generative Adversarial Networks (GANs), and Development Tools for Expert Systems.	5	CO6	L4
	Total	30		

Sr No.	List of Experiment	COs
1.	Design and Analysis of PEAS for Real-World Intelligent Agents	CO2
2.	Classification of Agent Environments and Agent Types for Given Scenarios	CO2
3.	Implementation of a Simple Reflex Agent and Goal-Based Agent	CO2
4.	Implementation of Breadth First Search (BFS) and Depth First Search (DFS)	CO3
5.	Implementation of Uniform Cost Search and Iterative Deepening Search	CO3
6.	Implementation of Greedy Best First Search and A* Search Algorithms	CO3

7.	Implementation of Mini-Max Algorithm with Alpha-Beta Pruning	CO3
8.	Implementation of Forward Chaining and Backward Chaining Techniques	CO3
9.	Development of Simple PROLOG Programs for Knowledge Representation	CO4
10.	Computation of Prior and Posterior Probabilities and Bayesian Inference	CO5
11.	Implementation of a Basic Learning Model and Design of a Simple Rule-Based Expert System	CO 5
12.	Case study of any existing successful AI system	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 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. 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. Ivan Bratko, PROLOG Programming for Artificial Intelligence, Pearson Education, Third Edition.
2. D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall
3. Saroj Kaushik, Artificial Intelligence, Cengage Learning
4. Davis E. Goldberg, Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley, N.Y., 1989.
5. Patrick Henry Winston, Artificial Intelligence‖, Addison-Wesley, Third Edition
6. N. P. Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press.

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach —Second Edition" Pearson Education.
2. Elaine Rich and Kevin Knight Artificial Intelligence Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008
3. George F Luger Artificial Intelligence‖ Low Price Edition, Pearson Education., Fourth edition

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc22_cs56/preview
2. https://nptel.ac.in/courses/106105077
3. http://www.classcentral.com/course/independent-elements-of-ai-12469

Course Title: Software Engineering and Project Management												
Semester: V			Term: Odd				Course Code: 24CSDSPEC5021B					
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

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

Course Objectives: The course aims:

1. To provide the knowledge of software engineering discipline.
2. To understand requirements and analyze them.
3. To do planning and apply scheduling.
4. To apply analysis, and develop software solutions.
5. To demonstrate and evaluate real time projects with respect to software engineering principles and Apply testing and assure quality in software solution.
6. To understand the need of project management and project management life cycle.

Course Outcomes:

After successful completion of the course students will be able to:

1. Understand and use basic knowledge in software engineering.
2. Identify requirements, analyze and prepare models.
3. Plan, schedule and track the progress of the projects.
4. Design & develop the software solutions for the growth of society.
5. Apply testing and assure quality in software solutions.
6. Generate project schedules and can construct, design and develop network diagrams for different type of Projects.

Module	Contents	Hours	COs
I	**Introduction to Software Engineering** Nature of Software, Software Engineering, Software Process, Capability Maturity Model (CMM) Generic Process Model, Prescriptive Process Models: The Waterfall Model, V-model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, Agile process, Agility Principles, Extreme Programming (XP), Scrum, Kanban model **Self-Learning Topics:** Software development life cycle, Software Requirement specification	9	CO1
II	**Requirements Analysis and Cost Estimation** Software Requirements: Functional & non-functional – user-system requirement engineering process – feasibility studies – elicitation – validation & management – software prototyping – S/W documentation – Analysis and modelling Requirement Elicitation, Software requirement specification (SRS) 3Ps (people, product and process) Process and Project metrics Software Project Estimation: LOC, FP, Empirical Estimation Models - COCOMO II Model. **Self-Learning Topics:** Elicitation Techniques, cost estimation	7	CO2
III	**Design Engineering** Design Process & quality, Design Concepts, The design Model, Pattern- based Software Design. Architectural Design: Design Decisions, Views, Patterns, Application Architectures, Modeling Component level Design: component, Designing class based components, conducting component- level design, User Interface Design: The golden rules, Interface Design steps & Analysis, Design Evaluation **Self-Learning Topics:** Design Engineering, Design Process	8	CO3
IV	**Software Risk, Configuration Management** Risk Identification, Risk Assessment, Risk Projection, RMMM Software Configuration management, SCM repositories, SCM process Software Quality Assurance Task and Plan, Metrics, Software Reliability, Formal Technical Review (FTR), Walkthrough. **Self-Learning Topics:** Resources allocation, Project Risk	6	CO4
V	**Software Testing and Maintenance** Testing: Software Quality, Testing: Strategic Approach,	6	CO5

	Strategic Issues- Testing: Strategies for Conventional Software, Object oriented software, Web Apps Validating Testing - System Testing - Art of Debugging. Maintenance : Software Maintenance-Software Supportability- Reengineering - Business Process Reengineering - Software Reengineering - Reverse Engineering- Restructuring - Forward Engineering. **Self-Learning Topics:** Impact analysis, monitoring		
VI	**IT Project Management and Project Scheduling** Introduction, 4 P's, W5HH Principle, Need for Project Management, Project Life cycle and ITPM, Project Feasibility, RFP, PMBOK. Knowledge areas, Business Case, Project Planning, Project Charter and Project Scope. Project Scheduling: Defining a Task Set for the Software Project, Timeline charts WBS, Developing the Project Schedule, Network Diagrams (AON, AOA), CPM and PERT, Gantt Chart , Tracking the Schedule, Earned Value Analysis **Self-Learning Topics:** Project character and scope ,Risk management	9	CO6
	Total	**45**	

Exp. No.	List of Experiments	COs
1.	To prepare a Problem Statement for the mini project.	CO1
2.	To select and apply two traditional process models for selected projects.	CO2
3.	To apply agile process model for selected projects.	CO2
4.	To develop requirements specification and prepare Software Requirement Specification (SRS) document in IEEE format for a mini project	CO3
5.	To perform structured data flow analysis using Data Flow Diagram.	CO3
6.	To estimate the cost of a project using software metrics (LOC and FP analysis).	CO4
7.	To schedule the project using CPM/PERT.	CO5
8.	To track the project using Gantt chart.	CO5
9.	To write test cases for white box testing.	CO5

10.	To write test cases for black box testing.	CO5
11.	To prepare RMMM Plan.	CO6
12.	To perform Version control using Subversion.	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 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. 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. Software Engineering : A Precise Approach, Pankaj Jalote, Wiley India
2. Ian Sommerville, Software Engineering, 9th edition Pearson Education ISBN-13: 978-0- 13- 703515-1, ISBN-10: 0-13-703515-2
3. Pankaj Jalote, An integrated approach to Software Engineering, Springer/Narosa.

Text Books:

1. Roger S. Pressman, Software Engineering: A practitioner's approach, McGraw Hill
2. Rajib Mall, Fundamentals of Software Engineering, Prentice Hall India
3. John M. Nicholas, Project Management for Business and Technology, Education.

Useful Links:

1. https://onlinecourses.swayam2.ac.in/cec21cs21/preview
2. https://nptel.ac.in/courses/106101061
3. http://www.nptelvideos.com/video.php?id=911&c=9 4

Course Title: Advanced Operating System												
Semester: V			Term: Odd				Course Code: 24CSDSPEC5012C					
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	25	150

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

Course Objectives:

The course aims:

1. To understand the structure and functionality of modern operating systems.
2. To learn virtualization technologies and resource management techniques.
3. To analyze the principles of parallel and distributed computing systems.
4. To understand distributed objects, middleware, and Internet computing frameworks.
5. To study fault tolerance, failures, and recovery mechanisms in distributed environments.
6. To explore real-time, multimedia, and security aspects of modern computing systems.

Course Outcomes:

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

1. Explain the architecture and services of operating systems.
2. Apply virtualization concepts for efficient resource utilization.
3. Analyze the design and operation of parallel and distributed systems.
4. Illustrate the role of distributed objects, middleware, and Internet computing technologies.
5. Evaluate failure handling and recovery techniques in distributed environments.
6. Assess real-time, multimedia, and security requirements in modern computing systems.

Module	Contents	Hours	COs
I	**Operating System Fundamentals and Structure (7 Hours)** Introduction to operating systems, functions and services of operating systems, operating system structures and architectures, system calls, kernel design concepts, process and thread management, CPU scheduling techniques, memory management fundamentals, and case studies of modern operating systems.	7	CO1
II	**Virtualization and Resource Management** Concepts of virtualization, hardware virtualization, operating system virtualization, application virtualization, virtual machines and hypervisors, container-based virtualization, resource allocation and isolation, virtualization in cloud computing, performance considerations, and applications of virtualization technologies.	7	CO2
III	**Parallel and Distributed Systems** Fundamentals of parallel computing, multiprocessor and multicore architectures, characteristics and goals of distributed systems, communication models in distributed environments, distributed system architectures, synchronization and coordination mechanisms, distributed file systems, and applications of parallel and distributed computing	8	CO3
IV	**Distributed Objects, Middleware, and Internet Computing** Distributed object systems, remote procedure calls (RPC), remote method invocation (RMI), middleware concepts and services, service-oriented architecture (SOA), web services, microservices architecture, Internet computing models, and cloud-based Internet applications.	8	CO6

V	**Distributed Subsystems, Failures, and Recovery** Distributed subsystem design principles, logical clocks and event ordering, consistency and replication models, fault models in distributed systems, failure detection techniques, checkpointing and recovery mechanisms, reliability, availability, and fault tolerance in distributed computing environments.	7	CO4
VI	**Real-Time, Multimedia, and Security Systems (8 Hours)** Introduction to real-time operating systems, real-time scheduling techniques, multimedia systems and their resource requirements, multimedia synchronization and scheduling, security threats in operating and distributed systems, authentication mechanisms, access control models, cryptographic techniques, and security in distributed and Internet computing environments.	8	CO5
	Total	**45**	

Exp. No.	Experiment Title	CO Mapping
1	Study of Operating System Components and Architecture	CO1
2	Demonstration of Process Creation and Process States in Linux/Windows	CO1
3	Study of CPU Scheduling Algorithms using Simulation Tools	CO1
4	Installation and Configuration of a Virtual Machine using VirtualBox/VMware	CO2
5	Creation and Management of Multiple Virtual Machines	CO2
6	Study of Container-Based Virtualization using Docker	CO2
7	Demonstration of Parallel Processing using Multithreading Programs	CO3
8	Implementation of Inter-Process Communication (IPC) Mechanisms	CO3
9	Study of Distributed System Architecture and Communication Models	CO3
10	Demonstration of Remote Procedure Call (RPC) or Remote Method Invocation (RMI)	CO4
11	Study of Middleware Services and Web Service Communication	CO4
12	Exploration of Internet Computing Platforms and Cloud Services	CO4
13	Simulation of Fault Detection and Recovery in Distributed Systems	CO5

Exp. No.	Experiment Title	CO Mapping
14	Study of Checkpointing and Recovery Mechanisms in Distributed Systems	CO5
15	Demonstration of Real-Time Scheduling and Basic Security Mechanisms in Operating Systems	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 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. 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.

Text Books

1. Operating System Concepts, Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Wiley.
2. Modern Operating Systems, Andrew S. Tanenbaum, Herbert Bos, Pearson Education.
3. Distributed Systems: Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, Pearson Education.
4. Distributed Systems: Concepts and Design, George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, Pearson Education.

References

1. Operating Systems: Internals and Design Principles, William Stallings, Pearson Education.
2. Distributed Computing: Principles, Algorithms, and Systems, Cambridge University Press.
3. Real-Time Systems, Jane W. S. Liu, Pearson Education.
4. Computer Security: Principles and Practice, Pearson Education.

Online Learning Resources / Video Lectures

1. NPTEL – Operating Systems
    - NPTEL Operating Systems Course
2. NPTEL – Distributed Systems
    - NPTEL Distributed Systems Course
3. MIT OpenCourseWare – Operating System Engineering
    - MIT OCW Operating System Engineering
4. Stanford University – Distributed Systems (Video Lectures)
    - Stanford Distributed Systems Lectures

Course Title: Cryptography and System Security												
Semester: VI			**Term: Even**				**Course Code: 24CSDSPEC5021C**					
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	**-**	**-**	**3**	**-**	**-**	**3**	**20**	**20**	**60**	**-**	**-**	**100**

IAE: Internal Assessment Examination

ESE: End Semester Examination

CA: Continuous Assessment

Course Objectives:

The course aims:

1. To introduce cryptographic fundamentals and number theory.
2. To explain symmetric, hash-based, and public-key cryptography.
3. To familiarize students with authentication and PKI.
4. To introduce secure communication protocols and standards.
5. To develop skills in using cryptographic tools.
6. To enable the design of secure applications.

Course Outcomes:

1. Explain information security goals, classical cryptography, finite fields, and number theory.
2. Apply encryption and decryption techniques for confidentiality and authentication.
3. Evaluate message authentication and integrity verification mechanisms using cryptographic hashes.
4. Apply digital signature algorithms to ensure authentication and secure communication.
5. Analyze network attacks and evaluate security protocols such as SSL, IPSec, and PGP.
6. Design secure applications using cryptographic and authentication mechanisms.

Module	Contents	Hours	COs
I	**Introduction & Number Theory** Services, Mechanisms and attacks-the OSI security architecture Network security model-Classical Encryption techniques (Symmetric cipher model, mono-alphabetic and poly-alphabetic substitution techniques: Vigenère cipher, play fair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers, steganography) **Self-Learning Topics:** Prime number, hash function	8	CO1
II	**Block Ciphers & Public Key Cryptography** Data Encryption Standard-Block cipher principles-block cipher modes of operation Advanced Encryption Standard (AES)-Triple DES Blowfish-RC5 algorithm. Public key cryptography: Principles of public key cryptosystems: The RSA algorithm, The knapsack algorithm, El Gamal Algorithm. Key management – Diffie Hellman Key exchange **Self-Learning Topics:** Block Cipher Modes of Operation, data encryption standard	8	CO2
III	**Cryptographic Hashes, Message Digests and Digital Certificates** Authentication requirement – Authentication function, Types of Authentication, MAC – Hash function – Security of hash function and MAC –MD5 – SHA – HMAC – CMAC, Digital Certificate: X.509, PKI **Self-Learning Topics:** Fast computation, Collision Resistances	8	CO3
IV	**Digital signature schemes and authentication Protocols** Digital signature and authentication protocols: Needham Schroeder Authentication protocol, Digital Signature Schemes – RSA, EI Gamal and Schnorr, DSS **Self-Learning Topics:** Digital signature, Token-based authentication	7	CO6
V	**System Security**	7	CO4

	Authentication, Authorization Operating System Security: Memory and Address Protection, File Protection Mechanism, User Authentication. Linux and Windows: Vulnerabilities, File System Security Database Security: Database Security Requirements, Reliability and Integrity. **Self-Learning Topics:** Sensitive Data, Inference Attacks, Multilevel Database Security		
VI	**Web security** Web Security Considerations, User Authentication and Session Management, Cookies, SSL, HTTPS, SSH, Web Browser Attacks, Web Bugs, Clickjacking, Cross Site Request Forgery, Session Hijacking and Management, Phishing Technique, DNS Attack, Secure Electronic Transaction, Email Attacks, Firewalls, Penetration Testing **Self-Learning Topics:** Cross-Site Request Forgery, Security Misconfigurations	7	CO5
	Total	**45**	

Exp. No.	**List of Experiments**	**COs**
1.	Design and Implementation of a product cipher using Substitution and Transposition ciphers	CO1
2.	Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA/El Gamal.	CO1
3.	Implementation of Diffie Hellman Key exchange algorithm	CO2
4.	For varying message sizes, test integrity of message using MD-5, SHA-1, and analyse the performance of the two protocols. Use crypt APIs.	CO3
5.	Exploring wireless security tools like Kismet, NetStumbler etc.	CO5
6.	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.	CO4, 6

7.	Study of packet sniffer tools Wireshark :- 1. Observer performance in promiscuous as well as non-promiscuous mode. 2. Show the packets can be traced based on different filters.	CO1, 3
8.	Download and install Nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, etc. .	CO1, 3
9.	Detect ARP spoofing using Nmap and/or open source tool ARPWATCH and Wireshark	CO1, 6
10.	Use the NESSUS/ISO Kaali Linux tool to scan the network for vulnerabilities	CO5

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 / 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. Web Application Hackers Handbook by Wiley.
2. Computer Security, Dieter Gollman, Third Edition, Wiley
3. CCNA Security Study Guide, Tim Boyle, Wiley
4. Introduction to Computer Security, Matt Bishop, Pearson.
5. Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, Shahed Latif , O'Reilly
6. Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill

Text Books:

1. Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education.
2. Security in Computing, Charles P. Pfleeger, Fifth Edition
3. Network Security and Cryptography, Bernard Menezes, Cengage Learning.
4. Network Security Bible, Eric Cole, Second Edition, Wiley
5. Mark Stamp's Information Security Principles and Practice, Wiley

Useful Links:

1. https://nptel.ac.in/courses/106105031
2. https://onlinecourses.nptel.ac.in/noc22_cs03/preview
3. https://www.coursera.org/learn/basic-cryptography-and-crypto-api

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, TW: Term Work

Course Objectives:

1. To introduce a learner to the principles of Design Thinking
2. To familiarize a learner with the process (stages) of Design Thinking
3. To expose a learner to various case studies of Design Thinking

Course Outcomes:

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

1. To compare traditional approach to problem solving with the Design Thinking approach and discuss the principles along with the process of Design Thinking
2. To define a user persona using Empathy Mapping
3. To frame a problem statement using various Design Thinking tools
4. To select best idea among the ideas generated through various Design Thinking tools
5. To create prototypes using engineering principles
6. To test the prototypes and gather feedback for refining the prototype

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

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:

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** 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	10	1
II	**Module 2: Types of Research** Basic Research, Applied Research, Descriptive Research, Analytical Research, Empirical Research, Qualitative and Quantitative Approaches	8	2
III	**Module 3: Research Design and Sample Design** 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	8	3
IV	**Module 4: Research Methodology** Meaning of Research Methodology ,Stages in Scientific Research Process: Identification and Selection of Research Problem, Formulation of Research Problem, Review of Literature, Formulation of Hypothesis, Formulation of research Design, Sample Design , Data Collection, Data= Analysis, Hypothesis testing and Interpretation of Data, Preparation of Research Report	6	4
V	**Module 5: Formulating Research Problem** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	8	5
VI	**Module 6: Outcome of Research** Preparation of the report on conclusion reached, Validity Testing & Ethical Issues, Suggestions and Recommendation	5	6
	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 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. 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, *Research Methods for Business: A Skill Building Approach*, Wiley.
2. Donald R. Cooper & Pamela S. Schindler, *Business Research Methods*, McGraw Hill.
3. Zikmund, Babin, Carr & Griffin, *Business Research Methods*, Cengage Learning.

Text Books:

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

Course Title: Foreign Language – I (German)												
Semester: V			**Term: Odd**				**Course Code: 24OE50131C**					
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	**--**	**--**	**3**	**--**	**--**	**3**	**20**	**20**	**60**	**--**	**--**	**100**
Sustainable Development Goals Mapped: 4 , 11												

IAE: Internal Assessment Examination

ESE: End Semester Examination

CA: Continuous Assessment

Course Objectives:

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

Course Outcomes: Learner will be able to…

1. To 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 Sichbegrüßen (Greetings),Sichvorstellen (Self-introduction) Das Alphabet & Deutsche Buchstabiertafel (German Alphabet & Spelling),Beruf und Herkunftangeben (Professions & Origin) Wer bin ich? (Who am I?),Anderevorstellen (Introducing Others),Telefonieren (Telephoning),Rechnen (Basic Calculations)	08	1
II	Grammar Basics and Daily Expressions KonjugationPräsens: trinken / kommen / sein,Wiespätist es? /Wie viel Uhr istes?,DiePersonalpronomen,Formelloderinformell – du oder Sie?,Begrüßung und Verabschiedung,Verben – arbeiten / machen / sein Kurssprache: schreiben / lesen / hören / sprechen / sehenmarkieren / ergänzen / unterstreichen / kreuzen,Artikel: ein/eine/ein – kein/keine/kein – der/die/das	08	2
III	Vocabulary Building and Communication Singular/Plural – Nomen schreiben, lernen,DasWörterbuchAdjektive,WasistIhrHobby?,Länder in EuropaWährungen,Sprachen:Muttersprache/Fremdsprache,Un regelmäßigeVerben – sprechen / lesen / essen / sehen Was machen/tun Sie in der Freizeit?	08	3
IV	Cultural Awareness and Descriptions Die Landkarte von Europa,Sehenswürdigkeiten in Indien und Europa,UnsereHeimat,Häuser und WohnungstypenDas Arbeitszimmer, Schlafzimmer, Küche, Balkonetc.Einfamilienhaus, Altbauwohnung, Studentenwohnheim etc. Die Wohnung – Richtungen,Kompositabilden – Wörterkombinieren	07	4

V	Grammar Deep Dive and Routine Activities Es gibt…,Subjekt/Objekt - Nominativ / AkkusativVerben: haben, schlafen, finden (Konjugation + Akkusativ),Personalpronomen&Possessivartikel,Wochentage / Wochenende,Präsens / Präteritum: sein / waren, haben / hattenDer Tagesablauf / Mein Alltag,TrennbareVerben,Fragen: Ja/Nein-Fragen, Wann...? Wie lange...?,Die Jahreszeiten / Der Feiertag	07	5
VI	Practical Usage and Modal Verbs Präpositionen: auf / unter / vor / hinter / im / in / an / über / zwischen / neben,Negation: nicht / nein / nie,Zahlen: Kardinalzahlen / Ordinalzahlen,Wobekommt man was? (Places & Common Phrases),in der Schule, imSupermarkt, am Bahnhof, in der Bibliothek, etc.,DieFamilie: Beschreibung, Familienbaum, Berufe,Modalverben: können, müssen, möchten, wollen, sollen, dürfen	07	6
	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: Foreign Language - I (Japanese)

Semester: V	Term: ODD	Course Code:24OE50132C

Teaching Scheme							Evaluation Scheme					
Contact Hrs.			Credit Allotted			Total Credit	IAE 1	IAE 2	ESE	CA	Oral/Pract/ Tut.	Total
Th	Tu	Pr	Th	Tu	Pr							
3	–	–	3	–	–	3	20	20	60	–	–	100

Sustainable Development Goals Mapped: 4 , 11

IAE: Internal Assessment Examination

ESE: End Semester Examination

Course Objectives:

1. Develop basic Japanese communication skills through everyday conversations and classroom activities.
2. Learn Japanese scripts, vocabulary, particles, and sentence structures.
3. Apply grammar concepts such as verb tenses, counters, pronouns, and particles correctly.
4. Improve listening, speaking, reading, and writing skills through practice and revision.
5. Build confidence in using elementary Japanese in practical situations.

Course Outcomes:

After successful completion of the course students will be able to:

1. Understand Japanese scripts, greetings, basic vocabulary, and self-introduction expressions.
2. Read and write Hiragana and Katakana and use common classroom phrases correctly.
3. Construct simple Japanese sentences using basic particles and vocabulary.
4. Use family vocabulary, counters, pronouns, and date expressions appropriately.
5. Apply time expressions, days, and particles in sentence formation.
6. Use basic verb tense forms and particles accurately in simple communication.

Module	Contents	Hours	COs
I	**Introduction to Japanese Language** Introduction to Japanese language, Japanese scripts, Hiragana, greetings and basic phrases, suffixes related to nationality, language, and country. **Self-Learning:** Hiragana writing practice, greetings conversation, nationality vocabulary exercises, basic phrase reading	7	CO1
II	**Scripts and phrases** Katakana, classroom phrases, vocabulary building, word formation using Hiragana and Katakana, numbers (1–10), quizzes, dictation, and phrase-based activities. **Self-Learning:** Katakana writing practice, classroom phrase activities, number practice, dictation exercises	8	CO2
III	**Sentence structure & particle.** Basic sentence structures, sentence formation, conversational reading, particles (ka, mo, wa, no), numbers (11–50), suffixes for age, month, and year, and revision. **Self-Learning:** Sentence formation practice, particle usage exercises, conversational reading, number writing	8	CO3
IV	**Family and Counters** Vocabulary development, dates, family-related vocabulary, counters for people and objects, pronouns (kore, sore, are / kono, sono, ano), and sentence formation using pronouns. **Self-Learning:** Family vocabulary practice, pronoun usage exercises, date writing, counters practice	8	CO4

V	**Date and time & particle** Revision, sentence formation, days of the week, suffixes for hours and minutes, particles indicating time for actions, verb-based vocabulary, and sentence construction using verbs. **Self-Learning:** Days and time expression practice, verb sentence formation, particle usage activities, speaking exercises	8	CO5
VI	**Verb tenses & particle III** Verb tenses including present tense, past tense, non-past negative tense, and past negative tense; vocabulary enhancement; particles ((を)wo(で) de). **Self-Learning:** Verb tense exercises, vocabulary building, sentence construction using particles を and で, paragraph writing	6	CO6
	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 the entire syllabus.

Reference Books (R): Not applicable.

Text Books(T): Not applicable

Online References: Not applicable

Course Title: Basics of Marketing Management												
Semester: V			**Term: ODD**				**Course Code: 24OE5014C**					
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	**-**	**-**	**3**	**-**	**-**	**3**	**20**	**20**	**60**	**-**	**-**	**100**
Sustainable Development Goals Mapped: 4 , 11												

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

Course Objectives:

1. To introduce basic concepts and functions of marketing.
2. To help students understand consumer behavior and market segmentation.
3. To familiarize students with product, pricing, promotion, and distribution strategies.
4. To provide an understanding of modern marketing trends including digital and green marketing.
5. To enable engineering students to apply marketing principles in technology-driven environments.

Course Outcomes:

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

1. Define key marketing terms and explain the role of marketing in organizations...
2. Analyze consumer behavior and segment markets effectively
3. Apply the marketing mix (4Ps) in real-world scenarios.
4. Evaluate marketing strategies using SWOT and competitor analysis.
5. Identify and explain emerging marketing practices such as digital, green, and social marketing.
6. Integrate basic marketing knowledge into engineering projects and innovations

Module	Contents	Hours	COs
I	**Introduction to Marketing** Definition, nature, scope, and importance of marketing Core marketing concepts: Needs, Wants, Demand, Value, Exchange Evolution of marketing: Production to Relationship orientation Role of marketing in business and society **Self-learning Topic:** Case Study Analysis – How Apple Uses Marketing to Create Customer Value	**06**	CO1
II	**Understanding the Market and Consumer Behavior** Marketing environment: Micro and Macro Buyer decision process – stages and influencing factors Market segmentation: Bases and strategies Targeting and Positioning (STP) **Self-learning Topic:** Consumer Behavior Models (e.g., AIDA, Maslow's Hierarchy) and Their Real-World Applications	08	CO2
III	**Marketing Mix - Product and Price** Product: Levels, types, lifecycle, new product development Branding, Packaging, and Labeling Pricing: Objectives, strategies, and methods Factors affecting pricing decisions **Self-learning Topic:** Skimming vs. Penetration Pricing – Strategies Used by Tech Startups	08	CO3
IV	**Marketing Mix - Place and Promotion** Distribution channels: Types and functions Retailing, Wholesaling, and Logistics Promotion mix: Advertising, Sales Promotion, Public Relations, Direct Marketing, Personal Selling Integrated Marketing Communication (IMC) **Self-learning Topic:** Role of Influencer Marketing in Brand Promotion	08	**CO3**

V	**Strategic Marketing and Modern Trends** SWOT analysis and marketing planning BCG Matrix, Ansoff Matrix Digital Marketing: SEO, SEM, Social Media Marketing, Email Marketing E-commerce and m-commerce strategies **Self-learning Topic:** Google Ads vs. Social Media Ads – ROI Comparison and Strategy Design	**08**	**CO4, CO5**
VI	**Social Responsibility and Applications of Marketing** Green marketing and sustainability Ethical issues in marketing Rural marketing in India Applying marketing principles to engineering innovations/ startups **Self-learning Topic:** Marketing Strategies for Rural India – Case of Patanjali or Amul	07	**CO5, CO6**
	Total	**45**	

Suggested Activities and Mini Project:

- Case study analysis on marketing strategies of tech companies
- Group presentation on digital marketing tools
- Survey-based project on consumer behavior for a product
- Role-play for product launching and branding
- Design a basic marketing plan for an engineering project/startup

Evaluation and Assessment Scheme:

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. 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.
2. Ramaswamy & Namakumari, Marketing Management: Global Perspective Indian Context, Macmilla

Course Title: Employability Enhancement Program -IV (Data Security lab)												
Semester: V			Term: Odd				Course Code:					
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	-	-	1	1	-	-	-	25	-	25

Sr No.	List of Experiment
1	To implement data anonymization techniques for protecting sensitive information in datasets.
2	To encrypt and decrypt dataset contents using the AES algorithm.
3	To implement secure password hashing using the SHA-256 algorithm.
4	To verify data integrity using cryptographic hash functions.
5	To implement Role-Based Access Control (RBAC) for secure data access.
6	To implement digital signatures for dataset authentication and verification.
7	To implement k-anonymity for privacy-preserving data publishing.
8	To apply differential privacy techniques for secure data sharing.
9	To implement secure storage of datasets using encryption techniques.
10	To develop an intrusion detection system using machine learning algorithms.
11	To develop a phishing email detection system using machine learning.
12	To detect fraudulent credit card transactions using anomaly detection techniques.

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NAAC Accredited with Grade 'A+', Three Programs NBA Accredited

Bachelor of Technology

In

Computer Science & Engineering

(Data Science)

Final Year
Semester – VII

SJCEM : R–24C

Effective from Academic Year 2026-27

Program Structure for Final Year Computer Science and Engineering (Data Science)

(With Effect from 2026-2027)
Semester VII
SCHEME: SJCEMR–24 Scheme C

Course Code	Vertical	Course Name	Contact Hrs			Credit Allotted			Total Credits
			Th	Tut	Pr	Th	Tut	Pr	
24CSDSPCC701C	PCC	Big Data Analytics	3	-	2	3	-	1	4
24CSDSPCC702C	PCC	Deep Learning	2	-	2	2	-	1	3
24CSDSPEC701XC	PEC	Program Elective – V	3	-	2	3	-	1	4
24CSDSPEC702XC	PEC	Program Elective – VI	3	-	-	3	-	-	3
24OE701XC	OE	Open Elective III	3	-	-	3	-	-	3
24CSDSAEC701C	AEC	Employability Enhancement Program -VI (Communication)	-	-	2	-	-	1	1
24CSDSPRJ701C	PRJ	Capstone Project	-	-	4	-	-	2	2
Total			**14**	**0**	**12**	**14**	**0**	**6**	**20**

Course Code	Vertical	Course Name	Evaluation Scheme					
			IAE 1	IAE 2	ESE	CA	OR/PR	Total
24CSDSPCC701C	PCC	Big Data Analytics	20	20	60	25	25	150
24CSDSPCC702C	PCC	Deep Learning	20	20	60	25	-	125
24CSDSPEC701XC	PEC	Program Elective - V	20	20	60	25	-	125
24CSDSPEC702XC	PEC	Program Elective - VI	20	20	60	-	-	100
24OE701XC	OE	Open Elective III	20	20	60	-	-	100
24CSDSAEC701C	AEC	Employability Enhancement Program -VI (Communication)	-	-	-	25	-	25
24CSDSPRJ701C	PRJ	Capstone Project	-	-	-	25	50	75
Total			**100**	**100**	**300**	**125**	**75**	**700**

Semester VII

Program Electives Courses

Program Elective	Track 01		Track 02	
	Intelligence Systems		Advanced Algorithms and Systems	
Program Elective V	24CSDSPEC7011C	Applied Data Science	24CSDSPEC7012C	Advanced Computer Network
Program Elective VI	24CSDSPEC7021C	Game Theory	24CSDSPEC7022C	IoT and Edge Computing

Program Elective	Track 03		Track 04	
	Soft and Quantum Computing		Vision Technology	
Program Elective V	24CSDSPEC7013C	Soft Computing	24CSDSPEC7014C	Metaverse with AR/VR
Program Elective VI	24CSDSPEC7023C	Quantum Computing	24CSDSPEC7024C	User Experience Design with VR

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	24OE70131C	Foreign Language III - Japanese 2	24OE7014C	Basics of HR Management
	24OE70132C	Foreign Language III – German 2		

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Syllabus

for

Final Year

Computer Science & Engineering (Data Science)

Semester – VII

SJCEM : R–24C

(With Effect from 2026-27)

Course Title: Big Data Analytics												
Semester: VII			**Term: Odd**				**Course Code: 24CSDSPCC701C**					
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**	**25**	**150**

Sustainable Development Goals Mapped: 4, 8, 9, 11, 12, 13

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 MapReduce, 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:

Upon successful completion 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 MapReduce 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 analyzing big data.

.

Module	Course Content	Hours	COs	RBT Level
1	**Introduction to Big Data and Hadoop** Introduction to Big Data - Big Data characteristics and Types of Big Data. Traditional vs. Big Data business approach. Case Concept of Hadoop, Core Hadoop Components; Hadoop Ecosystem. **Self learning**:- Study of Big Data applications in Healthcare, Banking and E-Commerce .	06	1	L2
2	**Hadoop HDFS and MapReduce** Distributed File Systems: Physical Organization of Compute Nodes, Large-Scale File-System Organization. MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures. Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union ,Intersection, and Difference by MapReduce. **Self learning**:- Apache Spark framework and comparison with MapReduce .	10	2	L4
3	**NoSQL** Introduction to NoSQL, NoSQL Business Drivers NoSQL Data Architecture Patterns: Key-value stores, Graph stores, Columnfamily (Bigtable)stores, Document stores, Variations of NoSQL architectural patterns, NoSQL Case Study NoSQL solution for big data, Understanding the types of big data problems; Analysing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; NoSQL systems to handle big data problems. **Self learning**:-Study of MongoDB and Cassandra architecture	7	3	L3
4	**Mining Data Streams** The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing. Sampling Data techniques in a Stream Filtering Streams: Bloom Filter with Analysis. Counting Distinct Elements in a Stream, Count-Distinct Problem, Flageolet-Martin Algorithm, Combining Estimates, Space Requirements Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm, Decaying Windows.	8	4	L4

	Self learning:-Real-time stream processing using Apache Kafka			
5	**Real-Time Big Data Models** A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering Case Study: Product Recommendation Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities in a social graph. **Self learning:-** Sentiment Analysis and Recommendation Systems	8	5	L5
6	**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 Reading datasets and Exporting data from R, Manipulating and Processing Data in R, Using functions instead of script, built-in functions in R Data Visualization: Types, Applications **Self learning:-**Data Visualization using Tableau/Power BI and advanced plotting in R	6	6	L3
Total		**45**		

Sr No.	List of Experiment	COs
1	Study of Big Data characteristics, Hadoop architecture and Hadoop ecosystem.	1
2	Installation and configuration of Hadoop in pseudo distributed mode.	1
3	Perform basic HDFS operations such as file creation, upload, download and replication.	2
4	Write and execute a simple MapReduce program for word count application.	2
5	Implement MapReduce program for matrix multiplication or data aggregation.	3
6	Study and implementation of NoSQL database using MongoDB/Cassandra.	3
7	Perform CRUD operations using NoSQL database.	4
8	Implement Bloom Filter algorithm for stream filtering.	4

9	Implement Flajolet-Martin Algorithm for counting distinct elements in data streams.	5
10	Study and implementation of recommendation system using collaborative filtering.	5
11	Study of R programming basics: vectors, matrices, data frames and functions.	6
12	Data visualization in R using plots, histograms, bar charts and scatter plots.	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 COsshould be covered)

Attendance (Theory & Practical): 05 m33arks

Teacher Assessment Examination (TAE): 10 Marks

List of Teacher Assessment Examination (TAE):

- ➢ Assignment
- ➢ Case Study
- ➢ Debate
- ➢ Solution for Social Problems
- ➢ Field Visit
- ➢ Group Project
- ➢ Flipped Classroom
- ➢ Topic Review
- ➢ Quiz
- ➢ Mind Mapping
- ➢ Any other.

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

Reference Books:

1. Bill Franks , —Taming The Big Data Tidal Wave: Finding Opportunities In HugeData StreamsWithAdvancedAnalytics‖,Wiley.
2. Chuck Lam, —Hadoop inAction‖, Dreamtech Press
3. Jared Dean, —Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners, Wiley India Private Limited, 2014.
4. Jiawei Han and Micheline Kamber, —Data Mining: Concepts and Techniques‖, Morgan Kaufmann Publishers, 3rd ed, 2010.
5. Lior Rokach and Oded Maimon, —Data Mining and Knowledge Discovery Handbook‖, Springer, 2nd edition,2010.
6. Vojislav Kecman, —Learning and Soft Computing‖, MITPress, 2010.

Text Books:

1. Cre Anand Rajaraman and Jeff Ullman —Mining of Massive Datasets‖, Cambridge University Press.
2. Alex Holmes —Hadoop in Practice‖, Manning Press, Dream tech Press.
3. DT Editorial Services, —Big Data Black Book‖, Dreamtech Press

Useful Links:

- https://nptel.ac.in/courses/106104189
- https://www.coursera.org/specializations/big-data#courses
- https://www.digimat.in/nptel/courses/video/106106169/L01.html

Course Title: Deep Learning												
Semester: VII			**Term: Odd**				**Course Code: 24CSDSPCC702C**					
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: 3,4,9

IAE: Internal Assessment Examination

ESE: End Semester Examination

CA: Continuous Assessment

Course Objectives:

1. To learn the fundamentals of Neural Network.
2. To gain an in-depth understanding of training Deep Neural Networks.
3. To acquire knowledge of advanced concepts of Convolution Neural Networks, Autoencoders and Recurrent Neural Networks.
4. Students should be familiar with the recent trends in Deep Learning.

Course Outcomes:

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

1. Understand fundamental neural network concepts and architectures and apply for real-world applications.
2. Analyse training, optimization, and regularization techniques in deep neural networks
3. Apply autoencoder models and their variants for unsupervised learning and practical applications such as image compression.
4. Analyse convolutional neural network operations and architectures, including modern models, for supervised learning tasks.
5. Analyse and evaluate recurrent neural network models, including LSTM and GRU, for sequence learning tasks and handling temporal dependencies.
6. Apply and analyse generative adversarial network (GAN) architectures for image generation and related real-world applications.

Module	Course Content	Hours	COs	RBT Level
I	**Fundamentals of Neural Network** History of Deep Learning, Deep Learning Success Stories, Neural Network Architecture, Components of Neural Network. Multilayer Perceptron (MLPs), Sigmoid Neurons, Gradient Descent, Feedforward Neural Networks, Deep Networks**:** Three Classes of Deep Learning Basic Terminologies of Deep Learning. **Self-Learning Topic:** Applications of Neural Networks	4	1	L2
II	**Training, Optimization and Regularization of Deep Neural Network** Introduction to Feedforward Deep Neural Networks – Multi-Layer Feedforward Neural Networks (MLPs) and Learning Factors. Activation Functions and Loss Functions – Sigmoid, Tanh, ReLU, Softmax, and Cross-Entropy Loss. Learning with Backpropagation – Backpropagation Algorithm and Weight Updates. Optimization Techniques – Gradient Descent, AdaGrad, RMSProp. Regularization and Generalization – Overfitting, Bias–Variance Trade-off, and Regularization Methods. **Self-Learning Topic:** Advanced Optimization Algorithms, Regularization Techniques	6	2	L4
III	**Autoencoders: Unsupervised Learning** Introduction, Linear Autoencoder, Undercomplete Autoencoder, Overcomplete Autoencoders, Regularization in Autoencoders. Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders. Application of Autoencoders: Image Compression. **Self-Learning Topic:** Structure of Autoencoders, Application of Autoencoder: Image Denoising	5	3	L3

IV	**Convolutional Neural Networks (CNN): Supervised Learning** Convolution operation, Padding, Stride, Relation between input, output and filter size. CNN architecture: Convolution layer, Pooling Layer, Weight Sharing in CNN, Fully Connected NN vs CNN, Variants of basic Convolution function, Multichannel convolution operation, 2D convolution. **Self-Learning Topic:** Modern Deep Learning Architectures: LeNET	5	4	L4
V	**Recurrent Neural Networks (RNN)** Sequence Learning Problem, Unfolding Computational graphs, Recurrent Neural Network, Bidirectional RNN, Backpropagation Through Time (BTT), Limitation of " vanilla RNN" Vanishing and Exploding Gradients, Truncated BTT. Long Short Term Memory(LSTM): Selective Read, Selective write, Selective Forget, Gated Recurrent Unit (GRU). **Self-Learning Topic:** RNN Architectures, Applications of RNNs.	6	5	L5
VI	**Recent Trends and Applications** Generative Adversarial Network (GAN): Architecture. Applications: Image Generation, DeepFake. **Self-Learning Topic:** Discriminator Architecture, Training Dynamics.	4	6	L3
Total		**30**		

Sr No.	List of Experiment	COs
1	Implement Multilayer Perceptron algorithm to simulate XOR gate.	1
2	To explore python libraries for deep learning e.g. Theano, TensorFlow etc.	1
3	Apply any of the following learning algorithms to learn the parameters of the supervised single layer feed forward neural network. a. Stochastic Gradient Descent b. Mini Batch Gradient Descent c. Momentum GD d. Nestorev GD e. Adagrad GD	2

	f. Adam Learning GD	
4	Implement a backpropagation algorithm to train a DNN with at least 2 hidden layers.	2
5	Design the architecture and implement the autoencoder model for Image Compression.	3
6	Design the architecture and implement the autoencoder model for Image denoising.	3
7	Design and implement a CNN model for digit recognition application.	4
8	Design and implement a CNN model for image classification.	4
9	Design and implement LSTM model for handwriting recognition, speech recognition, machine translation, speech activity detection, robot control, video games, time series forecasting etc.	5
10	Design and implement GRU for any real life applications, chat bots etc.	5
11	Case Study: Generative Adversarial Network (GAN): Architecture	6
12	Case Study: GAN Applications: Image Generation, DeepFake	6

Evaluation and Assessment Scheme:

D. 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.

E. End Semester Theory Examination (ESE):

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

F. 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):

- ➢ Assignment
- ➢ Case Study
- ➢ Debate
- ➢ Solution for Social Problems
- ➢ Field Visit
- ➢ Group Project

- Flipped Classroom
- Topic Review
- Quiz
- Mind Mapping
- 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:

a. Deep Learning from Scratch: Building with Python from First Principles- Seth Weidman by O'Reilley.
b. François Chollet. Deep learning with Python (Vol. 361). 2018 New York: Manning.
c. Douwe Osinga. Deep Learning Cookbook, O'REILLY, SPD Publishers, Delhi.
d. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc.
e. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.

Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville. Deep Learning, MIT Press Ltd, 2016.
2. Li Deng and Dong Yu, Deep Learning Methods and Applications, Publishers Inc.
3. Satish Kumar "Neural Networks A Classroom Approach" Tata McGraw-Hill.
4. JM Zurada Introduction to Artificial Neural Systems, Jaico Publishing House.
5. M. J. Kochenderfer, Tim A. Wheeler. Algorithms for Optimization, MIT Press.

Useful Links:

- http://www.cse.iitm.ac.in/~miteshk/CS6910.html
- https://nptel.ac.in/courses/106/106/106106184/
- https://www.deeplearningbook.org/

Course Title: Applied Data Science												
Semester: VII			**Term: Odd**				**Course Code: 24CSDSPEC7011C**					
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: 4, 8, 9, 11, 12, 13												

IAE: Internal Assessment Examination

ESE: End Semester Examination

CA: Continuous Assessment

Course Objectives:

1. To introduce students to the basic concepts of data science.
2. To acquire an in-depth understanding of data exploration and data visualization.
3. To be familiar with various anomaly detection techniques.
4. To understand the data science techniques for different applications.

Course Outcomes:

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

1. Apply the data science process for data-driven problem solving.
2. Perform data exploration and visualization to derive meaningful insights.
3. Apply anomaly detection techniques to identify unusual patterns in datasets.
4. Analyze and implement time-series forecasting models for predictive analytics.
5. Evaluate forecasting results and interpret temporal data trends for decision-making.
6. Apply data science techniques and tools to solve real-world applications.

Module	Course Content	Hours	COs	RBT Level
1	**Modern Data Science and Intelligent Analytics** Data Science lifecycle and process models, motivation for Data Science techniques: data volume, variety, velocity, dimensionality, and complexity. Data science tasks and real-world applications, data acquisition and preprocessing, feature engineering, overview of predictive and prescriptive modeling, comparison of Data Science, Data Analytics, Business Analytics, and Artificial Intelligence. Introduction to Big Data ecosystems, cloud-based data science platforms, MLOps concepts, and responsible data science practices. **Self-Learning Topic:** Data-Centric AI and MLOps for Scalable	7	1	L2,L3
2	**Data Exploration** Types of data, Properties of data, Descriptive Statistics: Univariate Exploration: Measure of Central Tendency, Measure of Spread, Symmetry, Skewness: Karl Pearson Coefficient of skewness, Bowley's Coefficient, Kurtosis Multivariate Exploration: Central Data Point, Correlation, Different forms of correlation, Karl Pearson Correlation Coefficient for bivariate distribution, 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 **Self-Learning Topic:** Bayesian Data Analysis	8	2	L2,L3
3	**Methodology and Data Visualization** Methodology: Overview of model building, Cross Validation, K fold cross validation, leave-1 out, Bootstrapping Data Visualization Univariate Visualization: Histogram, Quartile, Distribution Chart Multivariate Visualization: Scatter Plot, Scatter Matrix, Bubble chart, Density Chart Roadmap for Data Exploration **Self-Learning Topic**: Interactive Dashboard Design	8	3	L3

4	**Anomaly Detection** Outliers, Causes of Outliers, Anomaly detection techniques, Outlier Detection using Statistics Outlier Detection using Distance based method, Outlier detection using density-based methods, SMOTE **Self-Learning Topic:** Autoencoders and GANs	7	4	L3,L4
5	**Time Series Forecasting** 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 **Self-Learning Topic:** Deep Learning Models for TSF	8	5	L3,L4
6	**Applications of Data Science** Predictive Modelling: House price prediction, Fraud Detection Clustering: Customer Segmentation. Time series forecasting: Weather Forecasting Recommendation engines: Product recommendation, Explainable AI (XAI) **Self-Learning Topic:** Responsible Data Science Applications	7	6	L4,L5
Total		**45**		

Sr No.	List of Experiment	COs
1	To study the fundamentals of Data Science, understand the Data Science Process, explore the motivation behind using Data Science techniques, and differentiate between Data Science and Data Analytics.	1
2	To analyse a dataset using univariate and multivariate statistical techniques by calculating measures of central tendency, measures of spread, skewness, kurtosis, and correlation.	2
3	Study of Inferential Statistics: Probability Distributions and Hypothesis Testing	2
4	Explore data visualization techniques.	3
5	Implement and explore performance evaluation metrics for Data Models (Supervised/Unsupervised Learning)	3

6	To understand the process of model building and evaluate machine learning models using Cross Validation techniques such as K-Fold Cross Validation.	3
7	Use SMOTE technique to generate synthetic data. (to solve the problem of class imbalance)	4
8	Outlier detection using distance based/density-based method.	4
9	Implement time series forecasting using Average Method, Moving Average Smoothing.	5
10	To study and implement various smoothing methods for time series forecasting using Linear Regression/ARIMA Model/evaluate their performance using forecasting error metrics.	5
11	Illustrate data science lifecycle for selected case study 1. Customer Segmentation 2. Fraud Detection	6
12	Illustrate data science lifecycle for selected case study House Price prediction 4. Product Recommendation	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. S.C. Gupta, V. K. Kapoor ―Fundamentals of Mathematical Statistics‖, S. Chand and Sons, New Delhi.
2. 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. 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: Game Theory												
Semester: VII			**Term: Odd**				**Course Code: 24CSDSPEC7021C**					
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	**-**	**-**	**3**	**-**	**-**	**3**	**20**	**20**	**60**	**-**	**-**	**100**

Sustainable Development Goals Mapped: 4,8,9,10,16

IAE: Internal Assessment Examination

ESE: End Semester Examination

CA: Continuous Assessment

Course Objectives:

1. To introduce the student to the notion of a game, its solutions concepts, and other basic notions and tools of game theory, and the main applications for which they are appropriate, including electronic trading markets.
2. To formalize the notion of strategic thinking and rational choice by using the tools of game theory, and to provide insights into using game theory in modelling applications.
3. To draw the connections between game theory, computer science, and economics, especially emphasizing the computational issues.
4. To apply game theory in searching, auctioning and trading.

Course Outcomes:

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

1. Analyse and discuss the notion of a strategic game and equilibria and identify the characteristics of main applications of these concepts.
2. Analyse and evaluate real-world situations using Nash Equilibrium by identifying key strategic aspects and applying appropriate game theoretic concepts.
3. Apply and analyse Bayesian game concepts to model real-world applications and implement virtual business scenarios using game theory.
4. Understand and apply the working principles of non-cooperative games in relevant scenarios.
5. Explain and analyze mechanisms for aggregating preferences in decision-making scenarios.
6. Analyse and evaluate the working principles of repeated games in strategic decision-making scenarios.

Module	Course Content	Hours	COs	RBT Level
1	**Fundamentals of Game Theory** Making rational choices: basics of Games – strategy – preferences – payoffs – Mathematical basics – Game theory – Rational Choice – Basic solution concepts-non-cooperative versus cooperative games – Basic computational issues finding equilibria and learning in games Typical application areas for game theory (e.g. Google's sponsored search, eBay auctions, electricity trading markets). Merkle Tree. **Self-learning Topic:** Probability Distributions, Statistical Inference	7	1	L2
2	**Games with Perfect Information** Strategic games – prisoner's dilemma, matching pennies - Nash equilibria – theory and illustrations – Cournot's and Bertrand models of oligopoly – auctions – mixed strategy equilibrium– zero-sum games – Extensive Games with Perfect Information – repeated games (prisoner's dilemma) – subgame perfect Nash equilibrium; computational issues. **Self-learning Topic:** Game Theory, Classical Games	8	2	L4
3	**Games with Imperfect Information** Games with Imperfect Information – Bayesian Games – Motivational Examples – General Definitions – Information aspects – Illustrations – Extensive Games with Imperfect – Information – Strategies – Nash Equilibrium – Beliefs and sequential equilibrium – Illustrations – Repeated Games – The Prisoner's Dilemma – Bargaining. **Self-learning Topic:** Strategic Interactions, Sequential Decision-Making	7	3	L3
4	**Non-Cooperative Game Theory** Non-cooperative Game Theory – Self-interested agents – Games in normal form – Analysing games: from optimality to equilibrium Computing Solution Concepts of Normal Form Games – Computing Nash equilibria of two- player, zero-sum games –Computing Nash equilibria of two-player, general sum games Identifying dominated strategies. **Self-learning Topic:** Strategic Form Games, Extensive Form Games	8	4	L3
5	**Mechanism Design Aggregating Preferences** Social Choice – Formal Model – Voting – Existence of social functions – Ranking systems – Protocols for Strategic Agents:	7	5	L4

	Mechanism Design – Mechanism design with unrestricted preferences – Efficient mechanisms – Vickrey and VCG mechanisms (shortest paths) – Combinatorial auctions – profit maximization Computational applications of mechanism design – applications in Computer Science –Google's sponsored search – eBay auctions – K-armed bandits. **Self-learning Topic:** Preference Aggregation Mechanisms, Bayesian Games			
6	**Repeated Games** Blockchain applications, Tools and case studies Repeated games: The Prisoner's Dilemma , The main idea ,Preferences ,Infinitely repeated games, Strategies ,SomeNash equilibria of the infinitely repeated Prisoner's Dilemma , Nash equilibrium payoffs of the infinitely repeated Prisoner's Dilemma when the players are patient ,Subgame perfect equilibria and the one-deviation property. **Self-learning Topic:** Strategies in Repeated Games, Learning in Repeated Games	8	6	L5
Total		**45**		

Evaluation and Assessment Scheme:

- **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.

- **End Semester Theory Examination (ESE):**

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

Reference Books:

1. M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2013.
2. N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani (Editors), Algorithmic Game Theory. Cambridge University Press, 2007.
3. Dixit and S. Skeath, Games of Strategy, Second Edition. W Norton & Co Inc, 2004.
4. Yoav Shoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press 2008.

Text Books:

1. An Introduction to Game Theory by Martin J. Osborne
2. M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2004

Useful Links:

- https://nptel.ac.in/courses/110104063
- https://onlinecourses.nptel.ac.in/noc19_ge32/preview

Course Title: Soft Computing												
Semester: VII			Term: Odd			Course Code: 24CSDSPEC7013C						
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	-	-	3	-	-	3	20	20	60	25	-	125
Sustainable Development Goals Mapped: 4, 8, 9, 10, 12												

IAE: Internal Assessment Examination

ESE: End Semester Examination

CA: Continuous Assessment

Course Objectives:

1. Artificial Intelligence, Various types of production systems, characteristics of production systems.
2. Neural Networks, architecture, functions and various algorithms involved.
3. Fuzzy Logic, Various fuzzy systems and their functions.
4. Genetic algorithms, its applications and advances.

Course Outcomes:

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

1. Learn about soft computing techniques and their application.
2. Analyze various neural network architectures.
3. Understand perceptrons and counter propagation networks.
4. Understand Counter Propagation Network.
5. Define the fuzzy systems.
6. Analyze the genetic algorithms and their applications.

Module	Content	Hours	COs	RBT Level
I	**Soft Computing** Introduction to soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing. Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies. Knowledge representation issues, Prepositional and predicate logic, monotonic and non monotonic reasoning, forward Reasoning, backward reasoning, **Self-Learning Topic:** Weak & Strong Slot & filler structures,	7	1	L2
II	**Neural Network** Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference b/w ANN and human brain, characteristic and applications of ANN, single layer network.	8	2	L2
III	**Perceptron** Perceptron training algorithm, Linear separability , Widrow & Hebb's learning rule/Delta rule, ADALINE, MADALINE, AI v/s ANN. Introduction of MLP, different activation functions, Error back propagation algorithm, derivation of BBPA, momentum, limitation, characteristics and application of EBPA.	8	3	L3
IV	**Counter propagation network** Architecture , functioning & characteristics of counter Propagation network, Hop field/ Recurrent network, configuration, stability constraints, associative memory, and characteristics, limitations and applications. Hopfield v/s Boltzman machine. Adaptive Resonance Theory: Architecture, classifications, Implementation and training. Associative Memory.	7	4	L4
V	**Fuzzy Logic** Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, Fuzzy systems: crisp logic, fuzzy logic, introduction & features of membership functions.	7	5	L5

	Fuzzy rule base system : Fuzzy propositions, formation, decomposition & aggregation of fuzzy Rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic.			
VI	**Genetic algorithm** Fundamental, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator ,Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional methods.	8	6	L5
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 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. Bart Kosko, Neural Network & Fuzzy System, PHI Publication, 1st Edition, 2009
2. Rich E, Knight K, Artificial Intelligence, TMH, 3rd Edition, 2012.

Text Books:

❖ S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, Wiley Publications, 2nd Edition, 2011.

Useful Links:

1.www.myreaders.info/html/soft_computing.html

Course Title: Quantum Computing												
Semester: VII			Term: Odd			Course Code: 24CSDSPEC7022C						
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:

1. To understand basics of quantum computing
2. To understand mathematics required for quantum computing
3. To understand building blocks of quantum computing and design algorithms
4. To understand quantum hardware principles and tools for quantum computing.

Course Outcomes:

After successful completion of the course, the learner will be able to …

1. Understand basic concepts of quantum computing
2. Illustrate building blocks of quantum computing through architecture and programming models.
3. Appraise various mathematical models required for quantum computing
4. Discuss various quantum hardware building principles.
5. Identify the various quantum algorithms
6. Describe usage of tools for quantum computing.

Module	Contents	Hours	COs	RBT Level
I	**Introduction to Quantum Computing** Motivation for studying Quantum Computing, Origin of Quantum Computing, Quantum Computer vs. Classical Computer, Introduction to Quantum Mechanics, Overview of Major Concepts in Quantum Computing, Qubits and Multi-Qubit States, Bloch Sphere Representation, Quantum Superposition, Quantum Entanglement, Major Players in the Industry (IBM, Microsoft, Rigetti, D-Wave, etc.) **Self- Learning Topic:** NISQ Era, Fault-Tolerant Quantum Computing	07	CO1	L2
II	**Mathematical Foundations for Quantum Computing** Matrix Algebra, Basis Vectors and Orthogonality, Inner Product and Hilbert Spaces, Matrices and Tensors, Unitary Operators and Projectors, Dirac Notation, Eigenvalues and Eigenvectors, Group Theory **Self- Learning Topic:** Lie Algebra Applications in Quantum Computing	05	CO2	L3
III	**Building Blocks for Quantum Program** Architecture of a Quantum Computing Platform, Details of Qubit System of Information Representation. Bloch Sphere Multi-Qubit States, Quantum Superposition of Qubits (Valid and Invalid Superposition), Quantum Entanglement, Useful States from Quantum Algorithmic Perspective (e.g., Bell State), Operations on Qubits: Measuring and Transforming Using Gates, Quantum Logic Gates and Circuits, No-Cloning Theorem and Quantum Teleportation. Programming Model for a Quantum Computing Program, Steps Performed on Classical Computer, Steps Performed on Quantum Computer, Moving Data Between Bits and Qubits **Self- Learning Topic:** Variational Quantum Circuits	05	CO3	L3

IV	**Quantum Algorithms and Error Correction** Quantum Algorithms, Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch–Jozsa Algorithm, Quantum Error Correction Using Repetition Code, Error Correction Codes, 3-Qubit Codes, Shor's 9-Qubit Error Correction Code. **Self- Learning Topic:** Hybrid Quantum-Classical Algorithms	05	CO4	L4
V	**Quantum Hardware** Ion Trap Qubits, The DiVincenzo Criteria, Lagrangian and Hamiltonian Dynamics in a Nutshell, Dynamics of a Translating Rotor, Quantum Mechanics of a Free Rotor, A Poor Person's Atomic Model, Rotor Dynamics and the Hadamard Gate, Two-Qubit Gates, The Cirac–Zoller Mechanism, Quantum Theory of Simple Harmonic Motion, A Phonon–Qubit Pair Hamiltonian, Light-Induced Rotor–Phonon Interactions, Trapped Ion Qubits, Mølmer–Sørenson Coupling, Cavity Quantum Electrodynamics (cQED), Eigenstates of the Jaynes–Cummings Hamiltonian, Circuit QED (cirQED), Quantum LC Circuits, Artificial Atoms Superconducting Qubits, Quantum Computing with Spins, Quantum Inverter Realized with Two Exchange-Coupled Spins in Quantum Dots, A 2-Qubit Spintronic Universal Quantum Gate. **Self- Learning Topic:** Topological Quantum Computing	5	CO5	L4
VI	**OSS Toolkits for Implementing Quantum Programs** IBM Quantum Experience, Microsoft Q, Rigetti PyQuil (QPU/QVM), Quantum Cloud Platforms **Self- Learning Topic:** Developing Quantum Applications using Qiskit Runtime	03	CO6	L5
	Total	**30**		

Textbooks

1. Michael A. Nielsen, *Quantum Computation and Quantum Information*, Cambridge University Press.
2. David McMahon, *Quantum Computing Explained*, Wiley, 2008.
3. Qiskit Textbook: https://qiskit.org/textbook-beta/
4. Vladimir Silva, *Practical Quantum Computing for Developers*, 2018.

References

1. Bernard Zygelman, A First Introduction to Quantum Computing and Information, 2018.
2. Supriyo Bandyopadhyay and Marc Cahay, Introduction to Spintronics, CRC Press, 2008.
3. Lars Jaeger, The Second Quantum Revolution: From Entanglement to Quantum Computing and Other Super-Technologies.
4. Giuliano Gladioli La Guardia, Quantum Error Correction Codes, Springer, 2021

Digital References:

1. https://onlinecourses.nptel.ac.in/noc21_cs103/preview
2. https://www.coursera.org/courses?query=quantum%20computing
3. https://www.cl.cam.ac.uk/teaching/1617/QuantComp/

Course Title: Finance and Accounting												
Semester: VII			Term: Odd				Course Code: 24OE7011C					
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	-	-	3	-	-	3	20	20	60	-	-	100

Sustainable Development Goals Mapped: 1, 4, 8, 10, 16

IAE: Internal Assessment Examination

ESE: End Semester Examination

CA: Continuous Assessment

Course Objectives:

1 Understand the basic concepts of managerial economics, demand analysis, and elasticity of demand.

2 Apply break-even analysis and pricing strategies in business decision-making.

3 Analyze business organizations, economic policies, and cost accounting methods.

4 Evaluate accounting procedures and preparation of financial statements.

Course Outcomes:

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

1. Explain the concepts and scope of managerial economics and demand analysis.
2. Analyze elasticity of demand and apply demand forecasting methods.
3. Apply break-even analysis and pricing strategies for business decisions.
4. Evaluate business organizations and the impact of economic policies.
5. Prepare cost sheets using cost accounting techniques.
6. Prepare financial statements using accounting principles and procedures.

Module	Content	Hours	COs	RBT Level
1	**Introduction to managerial economics** Definition, nature and scope of managerial economics, demand analysis, demand determinants, law of demand and its exceptions	7	1	2
2	**Elasticity of Demand** Definition types measurement and significance of elasticity of demand. Factors governing demand forecasting, methods of demand forecasting (survey methods, statistical methods, expert opinion method, test marketing, controlled experiment, and judgmental approach to demand forecasting)	8	2	4
3	**Break even analysis and pricing strategies** Break even analysis-determination of breakeven point (simple problems) - managerial significance and limitations of BEA. Objectives and policies of pricing-methods of pricing: cost plus pricing, sealed bid pricing, going rate pricing, market skimming pricing, penetration pricing, two part pricing, block pricing, bundling pricing, peak load pricing, cross subsidization.)	8	3	3
4	**Business and New economic policy** Characteristics of business , features and evaluation of forms of business organization based on ownership, nature of the economy, structure of the economy, economic policies, new economic policy 1991, economic conditions	7	4	5
5	**Cost accounting Introduction-** Classification of costs –methods of costing – techniques of costing – preparation of cost sheet.	7	5	4
6	**Accountancy** Accounting principles, procedure-double entry system-journal-ledger, trail balance –cash book- preparation of trading, profit and loss account-balance sheet.	8	6	5
	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.

Textbooks:

1. Management Economics and Financial Analysis, Aryasri, 4/e, TMH, 2009.
2. Managerial Economics, Varshney & Maheswari, Sultan Chand, 2009.

Reference books:

1. Agarwal AN," Indian Economy "Wiley Eastern Ltd,New Delhi
2. Jain and Narang "Accounting part-1"Kalyani publishers
3. Arora,M.N."Cost Accounting", Vikas publications
4. Ashwatappa. K "Business Environment"

e-Resources and Digital Material:

1. http://nptel.ac.in/courses/110105067/
2. http://nptel.ac.in/courses/110107073/

Course Title: Intellectual Property Rights												
Semester: VII			Term: Odd			Course Code: 24OE7012C						
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	-	-	3	-	-	3	20	20	60	-	-	100

Sustainable Development Goals Mapped: 4, 8, 9, 16

IAE: Internal Assessment Examination

ESE: End Semester Examination

CA: Continuous Assessment

Course Objectives:

1. To understand the fundamentals and importance of Intellectual Property Rights (IPR).
2. To learn various types of IPR such as patents, copyrights, trademarks, and designs.
3. To understand procedures related to registration, protection, and infringement of IPR.
4. To gain knowledge of IT Act 2000, cyber laws, and digital security concepts.

Course Outcomes:

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

1. Explain the basics of IPR, TRIPS, and WTO.
2. Describe patent and copyright registration, rights, and infringement.
3. Analyze copyright protection and software piracy issues.
4. Examine trademarks, domain names, and legal remedies
5. Apply concepts of industrial design and layout protection.
6. Evaluate provisions of IT Act 2000 and cybercrimes

Module	Content	Hours	COs	RBT Level
1	**INTRODUCTION TO IPR:** Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights Introduction to TRIPS and WTO. Kinds of Intellectual property rights—Copy Right, Patent, Trade Mark, Trade Secret and trade dress, Design, Layout Design, Geographical Indication, Plant Varieties and Traditional Knowledge.	8	1	2
2	**PATENT RIGHTS AND COPY RIGHTS**— Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties. – 6 hours	8	2	3
3	**COPY RIGHT**—Origin, Definition &Types of Copy Right, Registration procedure, Assignment & licence, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software.	8	3	4
4	**TRADE MARKS**— Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties. Domain Names on cyber space.	7	4	4
5	**DESIGN**- Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000.	7	5	3
6	**BASIC TENENTS OF INFORMATION TECHNOLOGY ACT-2000 –** IT Act - Introduction E- Commerce and legal provisions E- Governance and legal provisions Digital signature and Electronic Signature. Cybercrimes,	7	6	5

Text books:

1 N.K. Acharya, *Textbook on Intellectual Property Rights*, Asia Law House, 2017.

2 Deborah E. Bouchoux, *Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets*, Cengage Learning, 2013.

3 P. Narayanan, *Intellectual Property Law*, Eastern Law House, 2017.

Reference books:

1 W.R. Cornish, *Intellectual Property Rights*, Universal Book Traders, 2010.

2 V.K. Ahuja, *Law Relating to Intellectual Property Rights*, LexisNexis, 2017.

3 S.K. Roy Chaudhary & H.K. Saharay, *The Law of Trademark, Copyright, Patents and Designs*, Eastern Law House, 2011.

4 Farooq Ahmad, *Cyber Law in India*, Pioneer Books, 2015.

5 Vakul Sharma, *Information Technology Law and Practice*, Universal Law Publishing, 2011.

e-Resources and Digital Material:

1. https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr25_ed87
2. https://nptel.ac.in/courses/109106137

Course Title: Foreign Language - III (Japanese-2)

Semester: VII	Term: Even	Course Code: 24OE70131C

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	-	-	3	-	-	3	20	20	60	-	-	100

Sustainable Development Goals Mapped: 4 , 11

IAE: Internal Assessment Examination

ESE: End Semester Examination

CA: Continuous Assessment

Course Objectives:

1. Demonstrate basic Japanese communication skills for daily conversations and interactions.
2. Explain fundamental Japanese grammar, vocabulary, particles, and sentence structures.
3. Apply verb forms, adjectives, and common expressions in practical communication situations.
4. Develop listening, speaking, reading, and writing skills through structured practice activities.
5. Communicate effectively in elementary Japanese within familiar real-life contexts.

Course Outcomes:

After successful completion of the course students will be able to:

1. Apply self-introduction patterns, basic verb tenses, particles, suffixes, and counters in elementary Japanese communication.
2. Use vocabulary and grammar related to time, dates, and daily activities in simple conversations and written expressions.
3. Construct sentences using transitive verbs, particles, and invitation sentence patterns accurately.
4. Differentiate between *i-adjectives* and *na-adjectives* and use them appropriately in communication.
5. Formulate sentences using various tense forms of *i-adjectives* in spoken and written Japanese.
6. Describe existence, positions, and locations using suitable particles and expressions in Japanese.

Module	Course Contents	Hours	COs
I	**Introduction and revision family** Self-introduction, verb tenses, particles, suffixes, family chart, counters for people and objects, and revision activities. **Self-Learning:** Self-introduction practice, family tree preparation, counters practice, paragraph writing	6	CO1
II	**Time & Activities** Suffixes related to time and dates, vocabulary development, particles (no, de, to), expressions for likes and dislikes, introduction to Kanji, five basic Kanji characters, and expressions indicating wants/desires. **Self-Learning:** Daily routine writing, Kanji practice, likes/dislikes conversations, time expressions	8	CO2
III	**Transitive Verbs and Usage** Introduction to transitive verbs, usage of particle *wo*, grammar patterns for inviting someone, vocabulary enrichment, hobbies, introduction to five Kanji characters, and revision. **Self-Learning:** Sentence formation with transitive verbs, invitation dialogues, hobbies vocabulary, Kanji practice	8	CO3
IV	**Adjectives and usage.** *i*-ending adjectives, *na*-ending adjectives, appropriate usage of adjectives, tense forms of *na*-adjectives and nouns, daily-use vocabulary, and introduction to five Kanji characters. **Self-Learning:** Describing people and objects, adjective usage practice, picture description, Kanji writing	8	CO4
V	**Tenses of *i*-Ending Adjectives** Vocabulary enhancement, present negative, past negative, and past positive forms of *i*-ending adjectives, sentence structures using all tense forms, asking questions, adverbs, and sentence formation using adverbs. **Self-Learning:** Adjective tense exercises, descriptive paragraph writing, adverb usage, question-answer practice	8	CO5

VI	**Existence, Positions and Location** New adjectives, positions of living and non-living objects, particles (*ni*, *ga*), directions, introduction to five Kanji characters, and IAE–2 revision. **Self-Learning:** Location-based conversations, direction practice, object position description, Kanji revision	7	CO6
	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.

Course Title: Foreign Language – III (German-2)												
Semester: VII			Term: Odd				Course Code: 24OE50132C					
Teaching Scheme							Evaluation Scheme					
Contact Hrs.			Credit Allotted			Total Credit	Theory				Practical	Total
Th	Tu	Pr	Th	Tu	Pr		IAE 1	IAE 2	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:

1. To develop students' ability to communicate confidently in German through day-to-day conversations, role plays, and practical situations.
2. To strengthen intermediate German grammar skills, including cases (Nominativ, Akkusativ, Dativ), separable verbs, conjunctions, past tense forms, sentence connectors, and question formation.
3. To enable students to describe daily schedules, routines, and activities using appropriate vocabulary and time expressions.
4. To enhance reading comprehension skills through German passages, dialogues, advertisements, emails, and simple articles.

Course Outcomes:

Learner will be able to

1. Communicate effectively in German for everyday situations related to travel, shopping, health, and workplace interactions.
2. Apply intermediate German grammar, including cases, modal verbs, separable verbs, and past tense forms.
3. Describe past experiences, future plans, and personal opinions using appropriate tenses.
4. Interpret short German texts, emails, advertisements, and articles.
5. Compose simple paragraphs, emails, invitations, and descriptions in German.
6. Demonstrate conversational skills in common real-life situations.

Module	Contents	Hours	COs
I	**Intermediate Grammar and Sentence Structure** Numbers,Time ,Opposites, Akkusativ & Dativ Case (*Nominativ / Akkusativ / Dativ*),Dativ Verbs: *helfen, danken, gefallen*,Wechselpräpositionen (*in, an, auf, unter, vor, hinter, zwischen*),wer-wen-wem-was Frage	08	1
II	**Communication in Daily Life** Dativ mit Präpositionen,Ja-Nein-Doch,Wegbeschreibung und Orientierung,In der Stadt / Verkehrsmittel,Am Bahnhof / Am Flughafen,Dialoge im Alltag,E-Mails und kurze Nachrichten schreiben	07	2
III	**Vocabulary Building and Communication** **Tagesablauf & Uhrzeit** Daily routine vocabulary,Sequencing activities,Time expressions,Akkusativ Prespositions **Kleidung & Einkaufen** Colors, sizes, prices,clothes vocabulary,Dialogue in shops gefallen + dative,möchten , mögen verbs,Food & drinks Vocabulary,Ordering food,Preferences and quantities.	08	3
IV	**Communication** **Gesundheit & Beim Arzt** Body parts,Symptoms and advice,Imperative basics **Wohnung & Möbel** Rooms and furniture vocabulary,Articles and plural forms **Meine Heimat** Short paragraphs and descriptions,Conjuctions (ADUSO),Sentence connectors: und, aber, denn	07	4

V	**Grammar Deep Dive and Routine Activities** Perfekt -haben / sein + Partizip II,Regular and irregular verbs **Zeitangaben & Reihenfolge** zuerst, dann, danach, später,am Morgen, am Abend **Wetter und Jahreszeiten** Weather expressions,Seasonal activities	07	5
VI	**Practical Usage of Grammar** **Einkaufen und Dienstleistungen** Shops, offices, stations, pharmacies,Requests and polite questions,Wo-Wohin Frage ,House Vocabulary & Conversation,asking & giving directions,Fruits & Vegetables & Market Conversatio,Demonstrative Articles,Possesive Articles (Akkusativ-Dativ)	08	6
	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 HR Management												
Semester: VII			Term: Odd				Course Code: 24OE7014C					
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	-	-	3	-	-	3	20	20	60	-	-	100

Sustainable Development Goals Mapped: 1, 4, 8, 10, 16

IAE: Internal Assessment Examination

ESE: End Semester Examination

CA: Continuous Assessment

Course Objectives:

- ➢ Understand the basic concepts and functions of Human Resource Management.
- ➢ Analyze job analysis, HR planning, recruitment, and selection processes.
- ➢ Apply training and performance appraisal methods for employee development.
- ➢ Evaluate labour welfare, social security, and employee discipline practices.

Course Outcomes:

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

1. Understand the concepts, functions, and importance of Human Resource Management.
2. Analyze job analysis and human resource planning processes.
3. Apply recruitment, selection, and employee placement procedures.
4. Evaluate training and development methods for employee growth.
5. Analyze the process and methods of performance appraisal.
6. Evaluate labour welfare, social security, and employee discipline practices.

Module	Content	Hours	COs	RBT Level
I	**Human Resource Management:** Introduction, meaning, nature, scope of HRM - Importance and Evolution of the concept of HRM - Major functions of HRM - Principles of HRM	7	1	2
II	**Job Analysis:** Meaning, process of Job Analysis, methods of collecting job analysis data, Job Description and Job Specification, Role Analysis. Human Resource Planning: Objectives, Importance and process of Human Resource Planning, Effective HRP.	8	2	4
III	**Recruitment:** Definition, Constraints and Challenges, Sources and Methods of Recruitment, New Approaches to recruitment. Selection: Definition and Process of Selection. Placement: Meaning, Induction/Orientation, Internal Mobility, Transfer, Promotion, Demotion and Employee Separation.	8	3	3
IV	**Training and development**: Training v/s development, Training v/s Education, Systematic Approach to Training, Training Methods.	7	4	5
V	**Performance Appraisal:** Concept of Performance Appraisal, the Performance Appraisal Process, Methods of Performance Appraisal.	7	5	4
VI	**Social Security & Labour Welfare:** Workers' Participation in Management: Levels of Management participation, Methods/ Schemes of Workers' participation in Management. Social security in India, Scope, Types of Social security and welfare programmes, non-monetary welfare measure. Employee Discipline:	8	6	5

	Characteristics of a sound disciplinary system, Common causes of indiscipline in an organisation, Disciplinary procedure, Ways of handling grievances.			
	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 & Reference Books:

- Human Resource Management, Pathania, Batra, Pathak, Kalyani Publishers
- Human Resource Management, Durai, Pearson
- Human Resource Management, VSP Rao, Excel Books
- Human Resource Management, Khanka, S. Chand
- Human Resource Management Text & Cases, Ashwathappa
- Personnel & Human Resource Management, P. Subba Rao, HPH

Useful Links:

https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg21

http://www.digimat.in/nptel/courses/video/110105069/L01.html

Course Title: Employability Enhancement Program-VI (Communication)													
Semester: VII			Term: Odd				Course Code: 24CSDSAEC701C					
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							
--	--	02	--	--	01	01	--	--	--	25	--	25

Sustainable Development goals: 4, 8

Course Objectives:

1. To apply required interpersonal skills so as to face challenges at the global level.
2. To 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	CO
	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**

Reference Books:

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

Text Books:

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

Useful Links:

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

Course Title: Capstone Project												
Semester: VII			Term: ODD				Course Code: 24CSDSPRJ701C					
Teaching Scheme							Evaluation Scheme					
Contact Hrs.			Credit Allotted			Total Credit	IAE1	IAE 2	ESE	CA	Or/Pr/ Tut.	Total
Th	Tu	Pr	Th	Tu	Pr							
-	-	4	-	-	2	2	-	-	-	50	50	100

Sustainable Development Goals: "SDG mapping will be carried out based on the project topic and its relevance to sustainable development goals."

Introduction:

The Capstone Project is a final academic exercise that integrates knowledge and skills acquired during the program. It enables students to solve real-world problems through design, analysis, and implementation. The project enhances critical thinking, research ability, teamwork, and communication skills, preparing students for professional practice and industry requirements.

Important Note: The Capstone Project is introduced in Semester VII as a foundational project-based learning experience. In Semester VIII, students may opt for either a Major Project or an Internship. Students choosing an internship must complete the Capstone Project in Semester VII. Those opting for a Major Project may either continue the same project or undertake a new project in Semester VIII.

Course Objectives:

The Project work facilitates the students to develop and prove Technical, Professional and Ethical skills and knowledge gained during graduation program by applying them from problem identification, analyzing the problem and designing solutions.

Course Outcomes:

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

Students will be able to develop the understanding of the problem domain through extensive review of literature.

- Students will be able to identify and analyze the problem in detail to define its scope with problem specific data.
- Students will be able to identify various techniques to be implemented for the selected problem and related technical skills through feasibility analysis.
- Students will be able to design solutions for real-time problems that will positively impact society and environment.
- Students will be able to develop clarity of presentation based on communication, teamwork and leadership skills.
- Students will be able to inculcate professional and ethical behavior..

Guidelines:

Project Topic Selection and Allocation:

- Project topic selection Process to be defined and followed:
- Project orientation can be given at the end of sixth semester.
- Students should be informed about the domain and domain experts whose guidance can be taken before selecting projects.
- Student's should be recommended to refer papers from reputed conferences/ journals like
- IEEE, Elsevier, ACM etc. which are not more than 3 years old for review of literature.
- Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements. Students can be informed to refer Digital India portal, SIH portal or any other hackathon portal for problem selection.
- Topics can be finalized with respect to following criterion:
- **Topic Selection**: The topics selected should be novel in nature (Product based, Application based or Research based) or should work towards removing the lacuna in currently existing systems.
- **Technology Used:** Use of latest technology or modern tools can be encouraged**.**
- Students should not repeat work done previously (work done in the last three years).
- Project work must be carried out by the group of at least 2 students and maximum 4.
- The project work can be undertaken in a research institute or organization/Industry/any business establishment. (out-house projects)
- The project proposal presentations can be scheduled according to the domains and should be judged by faculty who are expert in the domain.
- Head of department and senior staff along with project coordinators will take decision regarding final selection of projects.
- Guide allocation should be done and students have to submit weekly progress report to the internal guide.
- Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding continuous assessment marks.
- In case of industry/ out-house projects, visit by internal guide will be preferred and external members can be called during the presentation at various levels

Project Report Format:

At the end of semester, each group need to prepare a project report as per the guidelines issued by the institute.

A project report should preferably contain at least following details:

- Abstract
- Introduction
- Literature Survey
- Survey of Existing systems
- Limitations of Existing systems or research gaps
- Motivation (Challenges that are encouraging to choose the problem)
- Problem Statement and Proposed Solution
- Scope of the system
- Proposed System
- General Workflow/Block diagram
- Analysis and Modeling (only applicable diagrams)
- Design
- Architectural View
- Algorithms/ Methodology
- Experimental Set up
- Details of Database or details about input to systems or selected data
- Performance Evaluation Parameters (for Validation)
- Software and Hardware Set up
- Implementation Plan for Next Semester
- Timeline Chart for Term1 and Term-II (Project Management tools can be used.)
- Summary
- References

Desirable

1. Students can be asked to undergo some Certification course (for the technical skill set that will be useful and applicable for projects.)

G. Continuous Assessment:

Distribution of marks for continues assessment shall be done based on following:

- ❖ Weekly Log Report
- ❖ Project Work Contribution
- ❖ Project Report (Spiral Bound) (both side print)
- ❖ Term End Presentation (Internal)

The final certification and acceptance of CA ensures the satisfactory performance on the above aspects.

H. Oral & Practical:

Oral &Practical examination (Final Project Evaluation) of Project 1 should be conducted by Internal and External examiners approved by the institute at the end of the semester.

Suggested quality evaluation parameters are as follows:

- ➢ Quality of problem selected
- ➢ Clarity of problem definition and feasibility of problem solution
- ➢ Relevance to the specialization / industrial trends
- ➢ Originality
- ➢ Clarity of objective and scope
- ➢ Quality of analysis and design
- ➢ Quality of written and oral presentation
- ➢ Individual as well as team work