CURRICULUM STRUCTURE

SECOND YEAR UG: B.TECH

COMPUTER SCIENCE AND ENGINEERING

REVISION: FRCRCE-2-25

Effective from Academic Year 2025-26
Board of Studies Approval: 28/02/2025
Academic Council Approval: 14/02/2025 & 08/03/2025

Dr. DEEPAK BHOIR Dean Academics	Dr. Jagruti Save HOD (CSE)	DR. SURENDRA RATHOD Principal

Preamble:

Greetings and congratulations to all the education partners Fr Conceicao Rodrigues College of Engineering for getting autonomous status to the college from the year 2024-25. University Grant Commission vide letter No. F. 2-10/2023(AC-Policy) dated 23rd Nov 2023 conferred the autonomous status to Fr. Conceicao Rodrigues College of Engineering, Fr. Agnel Ashram, Bandstand, Bandra (West), Mumbai 400050 affiliated to University of Mumbai for a period of 10 years from the academic year 2024-2025 to 2033-2034 as per clause 7.5 of the UGC (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations,2023. We look towards autonomy as a great opportunity to design and implement curriculum sensitive to needs of Learner, Indian Society and Industries.

Government of Maharashtra has also directed Autonomous Colleges to revise their curriculum in line with National Education Policy (NEP) 2020 through Government Resolution dated 4th July 2023. We commit to ourselves to the effective implementation of UGC Regulations and NEP 2020 in its spirit.

Based on recent recommendations of the GR, we are pleased to offer our holistic curriculum for 2024-28, a "**H-Tree Model"** of Engineering Education. A unique **"H-Tree Model"** of Engineering Education Curriculum is carefully designed to systematically develop IQ (Intelligence Quotient), PQ (Physical Quotient), EQ (Emotional Quotient) and SQ (Spiritual Quotient) of a learner. This curriculum aims at the development of an **all-rounded** personality with **holistic** approach to education in which learner receives **25% teacher-led learning, 25% peer learning, 25% self-learning and 25% experiential learning**. The curriculum model is outcome based that focuses on learning by doing. Curriculum is designed to provide multiple learning opportunities for students to acquire and demonstrate competencies for rewarding careers. It ensures multiple choices to leaner acquiring skills through systematic planning. It has 7 verticals aligned to GR recommendations with strong science, and mathematics foundation and program core, sequel of electives, Multidisciplinary Minor courses, humanities & management courses and sufficient experiential learning through projects and semester-long industry / research internship along with employable skill-based courses. Learner gets an opportunity to acquire skills through NSDC aligned courses during summer vacations. Learner also gets additional option to choose the kind of degree i.e. Honors or Double Minor or Honors with Research.

Various steps are taken to transform teaching learning process to make learning a joyful experience for students. We believe that this curriculum will raise the bar of academic standards with the active involvement and cooperation from students, academic and administrative units.

Curriculum Structure for UG Programs at Fr CRCE w.e.f. A.Y. 2025-26

Nomenclature of the courses in the curriculum	
Abbreviation	**Title**
BSESC	Basic Science & Engineering Science Courses
PCPEC	Program Core and Program Elective Courses
MDC	Multidisciplinary Courses
SC	Skill Courses
HSSM	Humanities, Social Sciences and Management
EL	Experiential Learning
LLC	Liberal Learning Courses
BSC	Basic Science Courses
ESC	Engineering Science Courses
PCC	Program Core Courses
PEC	Program Elective Courses
MDM	Multidisciplinary Minor
OE	Open Elective
VSEC	Vocational and Skill Enhancement Course
VSC	Vocational Skill Courses
SEC	Skill Enhancement Courses
AEC	Ability Enhancement Course
EEMC	Entrepreneurship, Economics and Management Course
IKS	Indian Knowledge System
VEC	Value Education
RM	Research Methodologies
CEFP	Community Engagement or Field Project
ELC	Experiential Learning Courses
PRJ	Project
INT	Internship
CC	Cocurricular Courses
HMM	Honors and Multidisciplinary Minor
DM	Double Minor
HR	Honors with Research

Credit Specification:

- Theory: 1 credit=13 to 15 hrs of teaching
- Lab: 1 Credit=26 to 30 hrs of lab work
- Studio Activities: 1 Credit= 26 to 30 hrs of creative activities
- Workshop Based Activities: 1 Credit=26 to 30 hrs of hands-on activities related to vocation/professional practice/skill based
- Seminar/Group Discussion: 1 Credit=13 to 15 hrs of participation
- Internship: 1 Credit=Per 2 weeks OR 36 to 40 hrs of engagement
- Field Based Learning/Practices: 1 Credit=26 to 30 hrs of learning activities
- Community Engagement Projects: 1 Credit=26 to 30 hrs of contact time along with 13 to 15 hrs of activities preparation, report writing, independent reading etc.

Credit requirements for four different options of the Degrees:

Degree/SEM	I	II	III	IV	V	VI	VII	VIII	Total
B.Tech with Multidisciplinary Minor	20	20	22	22	22	22	20	20	168
B.Tech with Double Minor (Multidisciplinary & Specialisation Minor)	20	20 +2*	22 +4*	22 +4*	22 +4*	22 +4*	20 +2$	20 +2$	188
B.Tech with Research and Multidisciplinary Minor	20	20 +2*	22 +4*	22 +4*	22 +4*	22 +4*	20 +2$	20 +2$	188

Optional Credits $ credits (2) to be earned in VII/VIII

Salient Features of Curriculum:

- ✓ Framed as per Government Resolution dated 4th July 2023 in line with National Education Policy (NEP) 2020.
- ✓ Minimum 168 choice-based credit structure with options of Degrees earning additional credits
- ✓ Unique 'H-Tree' Model of Curriculum: Hybrid model for holistic development with happy learning environment having bridge connecting verticals providing unique path for each learner for 3-dimensional growth, Life Long Learning, multiple entry-exit, inclusive model indicating equal distribution of central resources
- ✓ More emphasis on laboratory based and experiential learning
- ✓ More weightage to continuous assessment to reduce examination stress
- ✓ Mandatory Semester-long internship, courses with emotional & spiritual learning and skill-based learning aligned with NSDC framework
- ✓ Well balanced curriculum to attain Program Outcomes and skills of 21st century learner
- ✓ Curriculum is designed to create excitement among learners for education through stories, activities, collaboration, hackathon, contest, case studies, creative art etc.
- ✓ Curriculum is designed to make graduates responsible citizens of country with future ready skills to handle challenges of 21st Century

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

SEMESTERWISE CURRICULUM STRUCTURE

UG Computer Science and Engineering Program:

SEM-III

Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE1	MSE	ISE2	ESE	Total	Points	Total
25BSC12CS05	BSESC	BSC	Discrete Maths and Statistics	TH	2	20	30	20	30	100	2	2
25PCC12CS05	PCPEC	PCC	Analysis of Algorithms	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC12CS06	PCPEC	PCC	Data Structure	TH	3	20	50	30	50	150	3	4
				PR	2	20	-	30	-	50	1	
25PCC12CS07	PCPEC	PCC	Object Oriented Programming with JAVA	PR	2	20	-	30	-	50	1	1
25OE01	MDC	OE	1. Law for Engineers 2. Financial Planning, Taxation and Investment	TH	2	50	-	50	-	100	2	2
25MDMXX1	MDC	MDM	MDM Course-1	TH	2	20	30	20	30	100	2	2
25MDMXX2	MDC	MDM	MDM Course-2	TH	2	20	30	20	30	100	2	2
25AEC12CS02X	HSSM	AEC	Modern Indian Language	TH	2	50	--	50	--	100	2	2
25VEC12CS01	HSSM	VEC	Human Values and Professional Ethics	TH	1	50	-	50	-	100	1	2
				PR	2						1	
25CEP12CS01	EL	CEFP	Community Engagement Project	PRJ	4	50	-	50	-	100	2	2
25DMX1	DM	DM	Double Minor Course	TH	2	20	30	20	30	100	2	4*
				TU	2	20	-	30	-	50	2	
25HR02	HR	HR	Honors with Research	-	-	-	-	-	-	-	4	4*
25DM01/25HR 01	DM/HR	DM/HR	Introduction to Emerging Technologies	TH	2	50	-	50	-	100	2	2$
				Total	**TH:TU:PR 16:0:12=28**			-	-	**1100**	-	**22**

$ DM/HR 2 credits for Later Entry Students in second year

SEM-IV

Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE1	MSE	ISE2	ESE	Total	Points	Total
25BSC12CS06	BSESC	BSC	Linear Algebra and Business Statistics	TH	2	20	30	20	30	100	2	3
				TU	1	20	-	30	-	50	1	
25PCC12CS08	PCPEC	PCC	Computer Organization and Architecture	TH	2	20	30	20	30	100	2	2
25PCC12CS09	PCPEC	PCC	Database Management System	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC12CS10	PCPEC	PCC	Data Analytics and Visualization	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC12CS11	PCPEC	PCC	Competitive coding lab	PR	2	20	-	30	-	50	1	1
25OE02	MDC	OE	1. Emerging Technology and Law 2. Principles of Management	TH	2	50	-	50	-	100	2	2
25VSE12CS03	SC	VSEC	Web Programming	PR	4	50	-	50	-	100	2	2
25MDMXX3	MDC	MDM	MDM Course-3	TH	2	20	30	20	30	100	2	2
25EEM12CS02	HSSM	EEMC	Technology Entrepreneurship	TH	2	50	-	50	-	100	2	2
25VEC12CS02	HSSM	VEC	Technology Innovation for Sustainable Development	TH	1	40	-	60	-	100	1	2
				PR	2						1	
25DMX2	DM	DM	Double Minor Course	TH	2	20	30	20	30	100	2	4*
				TU	2	20	-	30	-	50	2	
25HR03	HR	HR	Honors with Research	-	-	-	-	-	-	-	4	4*
25BC	BC	BC	MOOC	-	-	-	-	-	-	-	-	2$
				Total	**TH:TU:PR 15:1:12=28**			-	-	**1100**	-	**22**

$ Discipline specific additional course to Lateral Entry (Diploma) students from Swayam Plus/Swayam platform

List of Modern Indian Language (2 credit) (AEC):

- 25AEC12CS021 Sanskrit for Beginners
- 25AEC12CS022 Telugu for Beginners
- 25AEC12CS023 Kannada for Beginners
- 25AEC12CS024 Tamil for Beginners

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25BSC12CS05	Discrete Maths and Statistics	L	T	P	L	T	P	Total
		2	0	0	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	

Pre-requisite Course Codes		Matrices and Differential Calculus, Integral Calculus and Probability Theory
Course Outcomes	CO1	Apply propositional and predicate logic to solve problems and represent mathematical statements
	CO2	Analyze the implications of different types of relations and functions in various mathematical and real-world contexts
	CO3	Classify algebraic structures, Groups, Rings and solve problems using algebraic structures.
	CO4	Solve the real-world problems based on sampling and Normal probability distributions
	CO5	Develop and test a hypothesis about the population parameters to draw meaningful conclusions.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Logic**: Propositional Logic, Predicate Logic, Laws of Logic, Quantifiers, Normal Forms, Mathematical Induction.	1,2,4	3
2	2.1	**Relations**: Definition, Types of Relations, Representation of Relations, Closures of Relations, Warshall's algorithm, Equivalence relations and Equivalence Classes	1,2	6
	2.2	**Functions**: Definition, Types of functions, Composition of Functions, Invertible functions, Recursive functions		
	2.3	**Lattice**: Definition, Properties of Lattice, Sub lattice, Isomorphic Lattices		
3	3.1	**Algebraic structures**: Semi group, Monoid, Groups, Subgroups, Abelian Group, Cyclic group, Isomorphism, Ring	1,2,3	4
4	4.1	**Discrete & Continuous Probability Distributions**: Random variable, probability distribution, Std. deviation, variance, Binomial, Poisson and Normal Probability Distribution, Normal Curve, Standard Normal Probability Distribution	5	6
	4.2	**Sampling:** Sampling Methods, Central Limit theorem, Confidence Interval Estimation		
5	5.1	**Hypothesis Tests**: Developing Null and Alternative Hypotheses, Type I and Type II Errors, Population Mean: Known, Population Mean: Unknown, Inference About Means and Proportions with Two Populations	5	7

	5.2	**Tests of Goodness of Fit and Independence:** Goodness of Fit Test: A Multinomial Population, Test of Independence		
			Total	**26**

Course Assessment:

Theory:

ISE1: 20 Marks

Activity: Conduct any four activities (each of 5 marks) like Assignments/ quiz/ crossword/ tutorial/ case study/ programming on Logic, Relations, Functions and Algebraic structures

ISE2: 20 Marks

Activity: Conduct any two activities (each of 10 marks) like Assignments/ quiz/ crossword/ tutorial/ case study/ programming on Sampling, Hypothesis testing

MSE: 30 Marks 90 minutes written examination based on 50% syllabus

ESE: 30 Marks 90 Minutes written examination based on remaining syllabus after MSE

Recommended Books:

1. Rosen Kenneth: "Discrete Mathematics and its applications." McGraw Hill-New Delhi.
2. C. L. Liu, D. P. Mohapatra: "Elements of discrete mathematics: a Computer Oriented approach", 4th Edition, McGraw Hill-New Delhi.
3. B. Kolman, R. Busby, S. Ross: "Discrete Mathematical Structures",6th Edition, Pearson
4. Gary Haggard, John Schlipf, Sue Whitesides: "Discrete Mathematics for Computer Science", Thomson Brooks/Cole Publication
5. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: "Statistics for Business and Economics"11th Edition, South-Western, Cengage Learning

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25PCC12CS05	Analysis of Algorithms	2	- -	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE		Total
		Theory	20	30	20	30		100
		Lab	20	--	30	--		50

Pre-requisite Course Codes		Programming Fundamentals
Course Outcomes	CO1	Analyze the time and space complexity of algorithms.
	CO2	Apply divide and conquer strategy to solve a problem.
	CO3	Apply greedy strategy to solve optimization problem.
	CO4	Apply dynamic programming strategy to solve optimization problem.
	CO5	Apply backtracking and branch and bound strategies to solve a problem.
	CO6	Apply various string-matching algorithms to solve pattern matching problems

Module No.	Unit No.	Topics	Ref.	Hrs
1	1.1	**Introduction:** Performance analysis, space and time complexity calculations, Asymptotic notations. **Complexity class**: Solving Recurrence equations using Substitution, Recursion tree and Masters theorem	1,2	7
	1.2	**Divide and Conquer strategy:** General Concept, Quick sort, Merge sort, multiplying long Integers OR Finding minimum and maximum element of an array		
2	2.1	**Greedy Strategy:** General concept, Minimum Coin Change problem, Activity Selection problem. Fractional Knapsack Problem, Minimum Spanning Tree (Prim's and Kruskal's Algorithm), Dijkstra's Algorithm	1,2	4
3	3.1	**Dynamic Programming:** General Method, 0/1 knapsack problem, longest common subsequence, Bellman ford algorithm, Floyd Warshall algorithm, Multistage Graph, Assembly line scheduling	1,2	6
4	4.1	**Backtracking and Branch and bound:** Backtracking: General Method, N-queen problem, Graph coloring Problem, Sum of subsets Branch and Bound: Travelling Salesperson Problem, 15 Puzzle problem	1,2	6
5	5.1	**String Matching Algorithms:** The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm	1,2	3
			Total	**26**

Course Assessment:

Theory:

ISE1 & ISE2: Activities

- Quiz
- Problem solving score of hacker rank / code chef/leetcode
- Assignments
- Internal Coding Competition
- Certification course of 10-12hr duration on platform like coursera/udemy/NPTEL
- Design of an experiment

MSE: 30 Marks 90 minutes written examination based on 50% syllabus

ESE: 30 Marks 90 Minutes written examination based on remaining syllabus after MSE

Lab :

ISE1: will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks

ISE2: Rest five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks. Practical Exam on full syllabus for 10 marks

Module No.	Exp. No.	Suggested List of experiments
1	1	**Sorting:** Implement and analyze time and space complexity of Modified bubble, Insertion and Selection sort to display exam result of students based on their total marks scored.
	2	**Divide and Conquer:** Implement and analyze time and space complexity of Quick and Merge sort to display records of an employee working in any organization based on their work experience.
	3	**Divide and Conquer: (Any one)** I. Implement and Analyze time and space complexity of multiplying long Integers using divide and conquer strategy. II. Implement and Analyze time and space complexity of finding minimum and maximum element of an array using divide and conquer strategy
2	4 5	**Greedy Strategy**: **(Any 2)** I. Identify and implement an algorithm to be used to solve the challenge faced by airline and shipping companies of maximizing revenue while adhering to weight and space constraints when loading cargo onto airplanes or ships. determine the optimal selection and allocation of cargo items based on their values (revenue) and weights, ensuring efficient use of cargo space. II. Identify and implement an algorithm to be used in the construction of communication networks (telephone or internet networks) where a telecommunication company needs to lay down cables to connect several cities to establish a reliable

		network infrastructure. The company wants to minimize the cost of laying down cables while ensuring that all cities are connected and there is no redundancy in the network. III. Identify and implement an algorithm to be used by vending machines to determine the optimal combination of coins to give as change to customers.
3	6 7	**Dynamic Programming: (Any 2)** I. Identify and implement an algorithm to be used in disaster management and emergency response systems to find the shortest path for emergency vehicles, such as ambulances or fire trucks, to reach affected areas or victims. II. Identify and implement an algorithm to be used to compare DNA /RNA sequences to identify similarities and evolutionary relationships between organisms. III. Identify and implement an algorithm to be used by city planners and urban developers to determine the shortest paths between all pairs of locations, such as residential areas, commercial centers, and public facilities, to improve accessibility, reduce traffic congestion, and enhance urban mobility.
4	8	**Backtracking: (Any 1)** I. Implement N queen problem II. Identify and implement an algorithm to be used for coloring regions on a map such that adjacent regions do not have same color.
5	9	**String Matching:** Identify and implement an algorithm to be used by search engines to quickly locate documents containing specific keywords or phrases, improving search efficiency and response time.

Recommended Books:

1. T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005.
2. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms" University Press
3. Steven S. Skiena , "Algorithm Design Manual", Springer Publication
4. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw Hill Edition
5. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI

Online Resources:

1. https://nptel.ac.in/courses/106/106/106106131/
2. https://www.coursera.org/specializations/algorithms
3. https://www.mooc-list.com/tags/algorithms
4. https://www.youtube.com/watch?v=aGjL7YXI31Q&list=PLEbnTDJUr_IeHYw_sfBOJ6gk5pie0yP-0
5. https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/
6. Algorithm visualization tool https://visualgo.net/LeetCode/ HackerRank platform to solve challenging problems

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25PCC12CS06	Data Structure	3	- -	2	3	--	1	4
		Examination Scheme						
			ISE	MSE	ISE	ESE		Total
		Theory	20	50	30	50		150
		Lab	20	--	30	--		50

Pre-requisite Course Codes		Programming Fundamentals
Course Outcomes	CO1	Implement various operations of linear data structures.
	CO2	Implement various operations of non-linear data structures.
	CO3	Implement appropriate searching and hashing techniques on a given problem
	CO4	Apply appropriate data structure to solve different computing problems.

Module No.	Unit No.	Topics	Ref.	Hrs
1	1.1	**Introduction:** Introduction to Data Structures, Concept of ADT, Types of Data Structures: Linear and Nonlinear	1,2,3	3
2	2.1	**Stack and Queue:** **Stack:** Introduction, Stack as ADT, Operations, Implementation using array, Applications of stack: Infix to Postfix conversion, Evaluation of Postfix using stack	1,2,3	5
	2.2	**Queue:** Introduction, Queue as ADT, Operations, Implementation using array, Types of queue - Circular queue, Priority queue, Double ended queue, operations on these queues.	1,2,3	6
3	3.1	**Linked List:** Linked list as an ADT, Types of Linked List: Singly Linked List, Doubly linked list, Circular linked list concept, Operation on Singly and Doubly linked list, Applications of Linked List: Stack and Queue using Linked List. Polynomial representation and addition of two polynomials using Linked List.	1,2,3	8
4	4.1	**Tree:** Basic Terminology, Array and Linked Representation of Binary Tree ADT, Traversal of Binary Tree, Binary Search Tree and operations on it, AVL trees, Rotations, Operations on AVL Tree, Applications of these binary trees. Introduction to B tree and B+ tree.	1,2,3	8
5	5.1	**Graphs:** Basics Terminology, Adjacency List and Adjacency Matrix Representation, Graph traversals BFS and DFS.	1,2,3	5
6	6.1	**Searching Techniques and Hashing**: Linear Search and Binary Search, Hashing: Basic concepts, Hash function, Collision Resolution Techniques	2,3	4
			Total	**39**

Course Assessment:

Theory:

ISE1: Activity: Regular Quizzes of 20 Marks

ISE2: Activity: Quiz for 10 marks, Online Coding Challenge 20 Marks
Participation in online coding platforms like LeetCode, HackerRank, or Codeforces, where students can practice solving algorithmic problems related to data structures.

MSE: 50 Marks 120 minutes written examination based on 50% syllabus

ESE: 50 Marks 120 Minutes written examination based on remaining syllabus after MSE

Lab:

ISE1: Practical Exam after completing first five experiments (20 Marks)

ISE2: Assessment of Mini Project based on Rubrics (10 Marks)
Practical Exam based on full syllabus. (20 Marks)

Module No.	Exp. No.	Suggested List of experiments
1		**Stack ADT**
	1 2	a. Implement Stack ADT using array b. Convert Infix to Postfix and evaluate the postfix using Stack ADT
2		**Queue ADT (Any Two)**
	3 4	a. Implement Linear Queue ADT using array. b. Implement Circular Queue ADT using array. c. Implement Priority Queue ADT using array. d. Implement Double Ended Queue using array
3		**Linked List ADT**
	5 6 7	a. Implement Circular Linked List ADT. b. Implement Doubly Linked List ADT. c. Add two polynomials using Linked list.
4		**Binary Tree, BST ADT (Any Two)**
	8 9	a. Implement Binary Search Tree ADT using Linked List b. Construct an expression tree from given postfix form of expression. c. Implement a program to represent infix, prefix and postfix form of arithmetic expressions using binary tree traversal techniques. The expression is represented as a binary tree, where each operator is a parent node, and its operands are the left and right children
5		**Graph:**
	10	a. Implement a program to represent a graph using an adjacency list or adjacency matrix data structure. And perform breadth-first search (BFS) or depth-first search (DFS) traversal algorithms.
6		**Hashing**
	11	a. Implement a hash table data structure using an array and handle collisions using chaining (linked lists) and linear probing.
7	12	**Mini Project: (Suggested list of Mini Project Topics) (Any One)** a. Text Edition Application: Implement a text editor with an undo feature. Every time a change is made to the text, save the previous state. When the user performs an undo operation, last state should be

		reverted. b. Develop a print job scheduler. Users submit print jobs to the printer, and they are processed in the order they were received. c. Design and implement a music application to manage and organize playlists efficiently. The application should allow users to perform the following operations: Add song, Edit song, delete song, play song, d. Develop a browser history manager using a doubly linked list to efficiently track and navigate through the user's browsing history. The application should facilitate the following functionalities: Navigation forward and backward, Add page, remove page, search page, display history etc. e. Develop a word dictionary application to efficiently store and retrieve words and their definitions. The application should provide the following functionalities: Insertion, deletion, search, update etc. Given a network of cities connected by roads with different weights representing distances, find the minimum spanning tree to connect all cities with minimum total distance.

Recommended Books:

1. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, "Data Structures using C and C++", second edition, Pearson Publication
2. Reema Thareja, "Data Structures using C", Third Edition, Oxford University Press
3. Robert L. Kruse, Alexander J. Ryba, "Data Structures and Program Design in C++", Prentice-Hall India.
4. Data Structures and Algorithm Analysis in C by Mark Allen Weiss, second edition, Pearson Education India publication

Further Reading:

1. Michael H. Goldwasser, Michael T. Goodrich, Roberto Tamassia, "Data Structures and Algorithm in Java", Sixth Edition 2014, Wiley publication.
2. Richard F. Gilberg &Behrouz A. Forouzan, "Data Structures: Pseudocode approach with C", 2nd Edition, Cengage India Publication

Online Resources:

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://www.coursera.org/specializations/data-structures-algorithms
3. https://visualgo.net
4. www.leetcode.com
5. www.hackerrank.com
6. www.codechef.com

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
25PCC12CS07	Object Oriented Programming with JAVA	Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		Programming Fundamentals
Course Outcomes	CO1	Demonstrate Proficiency in Core Java Concepts
	CO2	Apply Object-Oriented Programming Principles
	CO3	Explore Java programming concepts including multithreading, File I/O, and exception handling
	CO4	Develop and Debug Java Applications

Module No.	Exp. No.	Topics
1	1	Introduction to Java Basics: Overview of Java programming language, setting up the development environment (IDE installation), Writing and executing your first Java program, Understanding variables and data types, Basic input/output operations, Control Structures and Functions **Suggested Experiment List: (Any One)** **Coffee Shop Problem** Develop a program for a coffee shop that calculates the total cost of a customer's order, including taxes and discounts, and prints the receipt. **Temperature conversion tool** Problem Statement: Create a temperature conversion tool that converts Celsius to Fahrenheit and vice versa, based on user input. **Parking Fee Calculator** Problem Statement: Implement a parking fee calculator that calculates the parking charges based on the duration of parking and the type of vehicle.
2	2	Introduction to object-oriented programming (OOP) concepts: Classes and objects in Java, Encapsulation, Association, and polymorphism **Suggested Experiment List: (Any One)** **Banking Application** Design a simple banking application that allows users to deposit, withdraw, and check their account balance. **Student Management System** Create a student management system that stores student information (name, roll number, marks) and provides functionality to add, delete, and update student records.
3	3	Inheritance: Types of Inheritance, Interface , Abstract class and methods, super and final keywords **Suggested Experiment List: (Any One)** **Shape Drawing Application**

		Design a shape drawing application that allows users to draw different shapes (circle, rectangle, triangle) on a canvas and perform operations like resizing and rotating. **Employee Payroll Processing** Create a program for managing employee payroll information, including salary calculation, deductions, and tax withholding. Allow HR personnel to add new employees, update salary information, and generate pay stubs.
4	4	Arrays and Vector: Arrays in Java, Vector. **Suggested Experiment List: (Any One)** **Library Management App:** Develop a program for a library that manages book inventory, allowing users to search for books by title or author **Contact Management App:** Build a contact management application that stores contact information (name, phone number, email) and provides features like searching, sorting, and exporting contacts.
5	5	Strings: Introduction to strings and string manipulation **Suggested Experiment List: (Any One)** **String Encoding:** Design a Java application that efficiently compresses a given string using any encoding technique, balancing between compression ratio and computational complexity. **Word Frequency:** Create a Java application for generating word clouds from textual data. Implement algorithms for frequency analysis, word weighting, and layout optimization to produce visually appealing representations of word distributions. **NLP:** Create a Java application for natural language processing that extracts named entities from a text corpus. Implement algorithms for recognizing and categorizing entities such as persons, organizations, locations, and dates.
6	6	Exception Handling: Handling exceptions in Java (try-catch-throw- throws-finally), User defined Exceptions **Suggested Experiment List: (Any One)** **Flight Booking System** Develop a program for a flight booking system that handles exceptions such as invalid input, seat availability, and payment errors. **Transportation Management** Create a Java program for a transportation management system that handles exceptions related to route planning, vehicle breakdowns, traffic congestion, and delivery delays. Implement resilience patterns like circuit breakers and retry mechanisms."
7	7	Multithreading: Introduction to Multithreading- lifecycle, creation of threads. Synchronization and Thread Communication, Handling Thread Interruption and Thread Pools. **Suggested Experiment List: (Any One)**

		Chat Application Develop a real-time chat application that allows multiple users to communicate with each other concurrently using separate threads for sending and receiving messages. **Social Media Platform** Build a simple social media platform where users can create profiles, connect with friends, and share posts. Implement features such as news feed, notifications, and privacy settings.
8	8	Introduction to JavaFx: Setting Up a JavaFX Application, Creating UI Elements, Event Handling in JavaFX **Suggested Experiment List: (Any One)** **Inventory management app** Design a simple inventory management system for a retail store that allows employees to add, update, and remove products from inventory using a graphical user interface. **Educational Game:** Create an educational game using JavaFX for teaching complex concepts in mathematics, physics, or computer science. Design engaging game play mechanics, interactive tutorials, and challenging puzzles to facilitate learning through exploration and experimentation.
9	9	Database Connection with Java: Setting Up Database Environment (MySQL/PostgreSQL), Establishing Database Connection, Executing SQL Queries, basics of Exception Handling **Demonstration** Program on Database Connection and Queries handling
10	10	File Handling: File Input / Output with Streams, Serialization and Deserialization, Random Access Files **Suggested Experiment List: (Any One)** **File Master App** Create a file management tool that allows users to organize and manage files and folders on their computer, including operations like creating, deleting, and renaming files. **Weather Forecasting Application** Develop a weather forecasting application that retrieves data from a file and displays current weather conditions and weather stats.
11	11	Mini Project: Defining the problem statement and objectives. Create UML diagram (Class diagram/ Usecase diagram) Implement the idea of Mini Project based on the content of the syllabus(Group of 2-3 students)

Course Assessment:

ISE1: will be conducted for (40-50%) experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE2: will be conducted for remaining experiments. Continuous pre-defined rubrics-based

evaluation for 20 marks, Mini project for 10 marks

Recommended Books:

1. Herbert Schildt, "Java: The Complete Reference", Nineth edition, McGraw Hill Education Publication
2. E. Balaguruswamy, "Programming with JAVA", Sixth edition, McGraw Hill Education Publication
3. Kathy Sierra and Bert Bates, "Head First Java: A Brain-Friendly Guide, 2Nd Edition", O'REILLY publication
4. Joshua Bloch, "Effective Java", third edition, Addison-Wesley Professional publication
5. Brian Goetz et al., "Java Concurrency in Practice", first edition, Addison-Wesley Professional publication
6. Mark Heckler, Gerrit Grunwald, José Pereda, Sean Phillips, Carl Dea, "JavaFX 8: Introduction by Example" second edition, Apress publication

Online Repository:

1. Java Course Online for Beginners by Scaler Topics
2. Java Tutorial for Complete Beginners by Udemy
3. Object-Oriented Programming in Java by Coursera
4. Java Programming by Great Learning
5. Core Java Basics by UpGrad
6. Practice Java by Building Projects on Udemy
7. Java for Absolute Beginners by Udemy

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
25OE011	Law for Engineers	Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		--
Course Outcomes	CO1	To demonstrate awareness of basic structure of Indian Legal System
	CO2	To demonstrate awareness of principles of contract
	CO3	To demonstrate awareness of legal aspects related to establishment of factory and various legislations related to employees, labours, and workmen's welfare
	CO4	To demonstrate awareness about right ot information, intellectual creations from infringement and laws related to energy, food and environment

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Foundation of Legal System**	1,2,3	4
	1.1	Indian Legal System: An Introduction, Human Rights, Fundamental Rights, The Supreme Court of India, Statutory Commissions– NHRC, NCW, NCM, NC-SC/ST etc.,		
	1.2	Representation of Peoples Act 1950, Prevention of Corruption Act, 1988, Understanding the Importance of Stamp Duty		
	1.3	Few Illustrated Cases of Supreme Court of India		
2		**General Principles of Contract: India Contract Act 1872**	2,3	8
	2.1	Contract Law: Agreement and Its Kinds,		
	2.2	Who Can Enter into a Contract, Contract and Its Enforceability, Offer and Acceptance in a Contract,		
	2.3	Essentials of Valid Contract- Lawful Consideration and Lawful Object, Essentials of Valid Contract- Free Consent,		
	2.4	Types of Contracts, Contract of Agency, Performance of Contracts, Government Contracts, Standard Form Contracts		
3		**Industrial and Labour Laws**	2,3	8
	3.1	Labour Laws in India: An Overview, Industrial Disputes Act, 1947, Industrial Employment (Standing Orders) Act, 1946		
	3.2	Factories Act, 1948, Industries (Development and Regulation) Act, 1951		
	3.3	Contract Labour (Regulation and Abolition) Act, 1970, Bonded Labour System (Abolition) Act, 1976, Child and Adolescent Labour (Prohibition and Regulation) Act, 1986		
	3.4	Workmens Compensation Act, 1923, Equal Remuneration Act, 1976, Payment of Bonus Act, 1965, Payment of Gratuity		

		Act, 1972, Employees' State Insurance Act, 1948, Employees' Provident Funds and [Miscellaneous Provisions] Act, 1952, Payment of Wages Act, 1936, Minimum Wages Act, 1948, Employees' Pension Scheme 1995		
	3.5	Apprentices Act, 1961, Maternity Benefit Act, 1961, Fatal Accidents Act, 1855, Trade Unions Act, 1926, Sexual Harassment of Women at Workplace Act, 2013, Collective Bargaining		
4		**Right to Information**	2,3	2
	4.1	Official Secret Act, 1923, Indian Evidence Act, 1872		
	4.2	Right to Information Act, 2005, Impact of Right to Information Act		
5		**Intellectual Property Rights**	2,3	2
	5.1	Types of Intellectual Property, Indian Copyright Act 1957, Indian Trademark Act 1999, Indian Patent Act 1970		
6		**Other Important Laws**	2,3	
	6.1	Electricity Act 2003, Atomic Energy Act 1962, Motors Vehicle Act 1988, Food Safety and Standards Act 2006, National Food Security Act 2013, Environment Protection Act 1986		2
			Total	**26**

Course Assessment:

ISE1: Quiz: 20Marks
Activity: Debating Session: 20 Marks
Activity: Poster Making: 10 Marks

ISE2: Quiz: 20 Marks
Activity: Client Counseling: 10 Marks
Activity: Animation Making: 20 Marks

Recommended Books:

1. N. S. Nappinai, "Technology Laws Decoded," LexisNexis, 2017
2. Vibha Arora and Kunwar Arora, "Law for Engineers" Central Law Publications, 2017
3. Vandana Bhatt and Pinky Vyas, "Laws for Engineers", ProCare, 2015

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25OE012	Financial Planning, Taxation, and Investment	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	50	--	50	--	100	

Pre-requisite Course Codes		--
Course Outcomes	CO1	To prepare financial plan by understanding owns need
	CO2	To demonstration awareness of taxation policies and show respect towards government norms and regulations
	CO3	To prepare investment plan by understanding owns futuristic needs

Financial Planning: It is possible to manage income more effectively through financial planning. Managing income helps to understand how much money is required for tax payments, other expenditures, and savings. It increases cash flows by carefully monitoring the spending patterns and expenses. Knowledge of comprehensive financial planning will help students to make right financial decisions in their life. It gives guidance in helping choose the right types of investments to fit needs, personality, and goals of their life. In this activity students need to prepare the financial plan for their life.

Taxation Policies: Taxes are levied in almost every country of the world, primarily to raise revenue for government expenditures, although they serve other purposes as well. The simple fact in economics is that there are certain common public goods and public needs that require some form of government and regulation to provide or promote. Taxation is the way to pay for these common goods. In this activity student will learn various types of taxes like Income tax, Corporate tax, Capital gains, Property tax, Inheritance and Sales tax.

Investments: Investments are important because in today's world, just earning money is not enough. But that may not be adequate to lead a comfortable lifestyle or fulfil our dreams and goals. Money lying idle in the bank account is an opportunity lost. Therefore, students should have a knowledge to invest money smartly to get good returns out of it. This activity will give insight to the students about investment in the form of Stocks, Mutual Funds, Fixed Deposits, Recurring Deposit, Public Provident Fund, Employee Provident Fund and National Saving Schemes.

Methodology: Guest lectures or workshops by professionals shall be arranged on Financial Planning, Taxation, and Investments. Invite guest speakers, such as tax professionals or financial advisors, shall conduct a tax planning workshop for students. The workshop can cover topics such as tax-efficient investment strategies, retirement planning, and tax-saving opportunities for individuals and businesses. Students should be engaged in assessment driven activities throughout the course. For better learning outcomes following methods of content delivery via student engagement can be adopted.

Investment Simulation Game: Divide students into groups and have them participate in a simulated investment game. Each group is given a virtual budget to invest in stocks, bonds,

mutual funds, or other investment vehicles. Throughout the course, they track the performance of their investments and make decisions based on real-world market trends and economic indicators.

Financial Planning Board Game: Design a board game that simulates the process of financial planning, including setting financial goals, creating budgets, managing debt, and making investment decisions. Students play the game in groups, competing or collaborating to achieve their financial objectives.

Stock Market Simulation: Use online stock market simulation platforms that allow students to buy and sell stocks in a virtual trading environment. They can experiment with different investment strategies, track the performance of their portfolios, and compete against their classmates or other teams.

Course Assessment:

ISE1: Quiz: **20 Marks**
Activity: Presentation on Financial Instruments: **10 Marks**
Activity: Preparing Investment Portfolio (20 Marks): Assign each student or group of students to create a hypothetical investment portfolio based on specific criteria such as risk tolerance, time horizon, and financial goals. They research different investment options, analyse their potential returns and risks, and justify their portfolio allocations in a written report or presentation.

ISE2: Quiz: **20 Marks**
Activity: Tax Return Case Studies (*Perquisite: Pan Card (if not available, student should immediately apply and get pan card))* (10 Marks):Consider case study of fictional individuals or families and prepare tax returns based on their financial situations. This hands-on activity allows students to apply their knowledge of taxation laws and regulations in a practical context.

Activity: Financial Literacy Podcast (10 Marks): Have students create their own podcasts or audio recordings discussing key concepts related to financial planning, taxation, and investments. They can ***interview experts***, share personal finance tips, or discuss current events and trends in the financial industry.

Activity: Personal Finance Blog (10 Marks): Students create their own personal finance blogs or websites where they share articles, tutorials, and resources related to financial planning, taxation, and investments. This activity helps them develop their writing and research skills while sharing valuable information with their peers

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25AEC12CS021	Sanskrit for Beginners	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50		50		100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		Basic Language skills
Course Outcomes	CO1	Demonstrate understanding of the Fundamentals of Sanskrit Language
	CO2	Apply Vocabulary and grammar skills for day-to-day conversation
	CO3	Developing Speaking and Learning skills

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Introduction: Some Unique characteristics of Sanskrit The Sounds of Sanskrit: Its Alphabet Sentence Construction and Its underlying logic Introduction of Self and Others Basic verbs and some conjugations	1-8	6
2	2.1	Introduction to Genitive (6^{th} Case) Counting and Reading the Time Plural of Pronouns and Nouns Conjugation of Basic Verbs in the Plural Introduction to the Locative (7^{th} Case)	1-8	6
3	3.1	Days of the week, Months, Future Tense Past Tense and More Verbs Introduction to the Accusative (2^{nd} Case) Introduction to the Instrumental (3^{rd} Case)	1-8	6
4	4.1	Introduction to the Ablative (5^{th} Case) Introduction to the Dative (4^{th} Case) Introduction to the Vocative (8^{th} Case)	1-8	6
	4.2	Stories and Motivational Shlok with word by word meaning	1-8	2
			Total	**26**

Course Assessment:

ISE1: Activities and Assignments: 20 Marks
Oral Examination: 30 Marks
ISE2: Activities and Assignments: 20 Marks
Oral Examination: 30 Marks

Recommended Books:

1. Kumari, S. "Sanskrita Chitrapada koshah," Mysuru: Bharatiya Bhasha Sansthanam, 1993
2. Samkrita-vyavahaara-sahasri (Samskrit-English), New Delhi: Sanskrita Bharati
3. Sampad, & Vijay, "The Wonder that is Sanskrit" Pondicherry: Sri Aurobindo Society, 2005.
4. Satvlekar, S. D. "Sanskrit Swayam Shikshak," Delhi: Rajpal & Sons, 2013
5. Shastri, V K. "Teach Yourself Samskrit: Prathama Diksha" Delhi: Rashtryia Sanskrita Samsthana, 2012
6. Vishwasa "Abhyāsa-pustakam", New Delhi: Samskrita Bharati, 2014
7. https://onlinecourses.nptel.ac.in/
8. https://www.learnsanskrit.org/

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25AEC12CS022	Tamil for Beginners	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50		50		100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		Basic Language skills
Course Outcomes	CO1	Demonstrate understanding of the Fundamentals of Tamil Language
	CO2	Apply Vocabulary and grammar skills for day to day conversation
	CO3	Developing Speaking and Learning skills

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Tamil Alphabets and Pronunciation** History of Tamil language	1	1
	1.2	Learning Tamil Alphabets		1
	1.3	Basic Pronunciation and Oral drills with visual learning		2
	1.4	Greetings and common expression		2
2	2.1	**Basic Grammar and Sentence Structure** Sentence Construction: Subject, Verb, Object (SVO)	1,2	2
	2.2	Present tense, Past tense and Future tense		2
	2.3	Common Nouns, Pronouns with negative imperatives		2
3	3.1	**Building Vocabulary for Everyday Conversation** Learning Numerals (Cardinal numbers) 1-20, 100. 200…1000	2,3	2
	3.2	Forming Simple sentences with interactive lessons		3
	3.3	Learning Days of week, Months of the year, Fruit, Food grains, Parts of the Body, Names of Common places like Hospitals, Market place, shops, Saloons etc.		3
4	4.1	**Daily life and Survival Phrases** Day to day usage of language for daily routines in conversation with Student to Teacher, Vegetable shop vendor, Railway Station, conversation with Auto Drivers, Hospitals …etc.	1	3
	4.2	Role Play exercises in common situations		3
			Total	**26**

Course Assessment:

ISE1: Activities and Assignments: 20 Marks
Oral Examination: 30 Marks

ISE2: Activities and Assignments: 20 Marks
Oral Examination: 30 Marks

Recommended Books:

1. Kesav, "A practical course to learn tamil for Absolute beginners" (Standard and Colloquial), Notion Press, 2020

2. Dr. R. Kalidasan, Dr. S. Velayuthan, "English Grammar-An easy way to learn with Tamil Explanation and key", Shanlax publisher, 2019
3. Oxford English-English Tamil Dictionary, Oxford.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25AEC12CS023	Kannada for Beginners	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		Basic Language skills
Course Outcomes	CO1	Demonstrate understanding of the Fundamentals of Kannada Language
	CO2	Apply Vocabulary and Grammar skills for day to day conversation
	CO3	Developing Speaking and listening skills

Module No.	Unit No.	Topics	Ref	Hrs
1	1.1	**Introduction to Kannada Alphabets and Pronunciation** History of Kannada Language	1,2	1
	1.2 1.3 1.4	Learning Kannada Alphabets Pronunciation and visual learning Greetings and Common expressions		1 2 2
2	2.1	**Basic Grammar and Sentence Structure with Subject, Verb, Objective (SVO)** Basics of Sentence Formation	1,3	2
	2.2 2.3	Present tense, Past tense, Future tense, and Introduction to Adjectives Common Nouns, Pronouns with negative imperatives		2 2
3	3.1	**Conversation Phrases and Language Vocabulary** Learning Numerals (Cardinal Numbers) 1-20 / 100 -1000	2,3	2
	3.2 3.3	Classified Sentences and Useful expressions Learning Days of week, Months of the year, Fruits, Food grains, Parts of the body, Names of common places like Hospitals, markets, shops, saloons, gender, weather etc.		3 3
4	4.1	**Developing Language fluency and Proficiency.** Day to day usage of Language for daily routine in conversation with Student to Teacher, vegetable vendor, in Railway station, with Auto driver, in Hospitals, etc.	1,2	3
	4.2	Role plays exercises in common situations		3
			Total	**26**

Course Assessment:

ISE1: Activities and Assignments: 20 Marks
Oral Examination: 30 Marks
ISE2: Activities and Assignments: 20 Marks
Oral Examination: 30 Marks

Recommended Books:

1. Upadhaya,U.P & N.K.Krishnamurthy, "Conversational Kannada" Prism Books, 2018
2. Thomas Hodson, "Grammar of the Kannada or Canarese language", Gyan publishing house, 2020
3. Ramanja Reddy Merugu , "Learn kannada through English" 2021
4. Dr.Prabhusankara & B.V.Sridhar," Oxford English-English-Kannada dictionary", Oxford Publications.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25AEC12CS024	Telugu for Beginners	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		Basic Language Skills
Course Outcomes	CO1	Demonstrate understanding of the fundamentals of Telugu Language
	CO2	Apply vocabulary and grammar skills for day-to-day conversation
	CO3	Developing Speaking and Listening skills

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Telugu Alphabets and Pronunciation** History of Telugu language	1,2	1
	1.2 1.3 1.4	Learning Telugu Alphabets and Symbols Basic Pronunciation Greetings and Common expressions		1 2 2
2	2.1	**Basic Grammar and Sentence Structure** Sentence Structure: Subject, verb, Object (SVO)	1,2	2
	2.2 2.3	Present tense, Past tense, and Future tense Common nouns, Pronouns, Adjectives		2 2
3	3.1	**Conversation Phrases for Daily Situations** Learning numerals (Cardinal Numbers) 1- 20, 100 -1000	1,4	2
	3.2 3.3	Forming Simple sentences / Listening and Speaking skills Days of week, Months of the year, Gender, Fruits, Parts of the body, Names of common places like hospitals, markets, shops, saloons etc.		3 3
4	4.1	**Common Phrases and Developing Language Fluency and Proficiency** Day to day usage of Telugu language for daily routines in conversation with Student to teacher, Vegetable Shop vendor, Railway passengers, Auto drivers, in Hospitals etc.	1,2,3	3
	4.2	Role Play Exercises in Common situations, presentation on Telugu culture, Telugu scripts, Telugu classical music, Telugu festivals.		3
			Total	**26**

Course Assessment:

ISE1: Activities and Assignments: 20 Marks
Oral Examination: 30 Marks

ISE2: Activities and Assignments: 20 Marks
Oral Examination :30 Marks

Recommended Books:

1. Sanjay,D, " Spoken Telugu for Absolute Beginners", Notion Press, 2019.
2. Praveen Ragi, "Learn Telugu Through English. V1" Evincepub Publications, 2020
3. Oxford compact English-English Telugu Dictionary
4. English- Telugu Conversation guide / Aarthi Janyavula , 2018

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		1	--	2	1	--	1	2
			Examination Scheme					
25VEC12CS01	Human Values and Professional Ethics		ISE1	MSE	ISE2	ESE		Total
		Theory	50	---	50	---		100
		Lab	---	---	---	---		---

Pre-requisite Course Codes		--
Course Outcomes	CO1	Adhere to the core rights and shape one's values.
	CO2	Display the role and responsibility of Engineering professionals
	CO3	Holds moral and Ethical solutions to problems through case studies.
	CO4	Apply the knowledge of human values to contemporary ethical and global issues.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Background and Approach: Fundamental Rights and Duties**	1,2	
	1.1	Fundamental Rights and Duties, Right to Compensation for being Illegally Deprived of one's Right to Life or Liberty, Right to Travel Abroad and Return to one's Country		2
	1.2	Promotion of Inter-Religious harmony and inter-faith values, Composite Culture		1
2		**Professional Ethics and Human Values**	1,2	
	2.1	Sense of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy Moral dilemmas, Moral Autonomy, Kohlberg's theory Gilligan's theory, Consensus and Controversy, Profession& Professionalism, Models of professional roles, Theories about right action Codes of Ethics, Plagiarism		3
	2.2	Human Values. Morals, values, and Ethics – Integrity- Academic integrity- Work Ethics- Service Learning- Civic Virtue Respect for others- Living peacefully- Caring and Sharing- Honestly- Cooperation Commitment Empathy- Self Confidence -Social Expectations.		2
	2.3	Managing conflict- Respect for authority- Collective bargaining- Confidentiality, Role of confidentiality in moral integrity-Conflicts of interest		2
3		**Global Ethical Concerns**	1,2	
	3.1	Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics		2
	3.2	Engineers as Expert witnesses and advisors-Moral leadership- case studies		1
			Total	**13**

Course Assessment:

ISE1: AICTE & UNESCO's certificate course on Self-directed Emotional Learning for Empathy and Kindness (SEEK) **30 marks**
Link: https://www.framerspace.com/course/seek (Select SEEK self- directed cohort under the category of youth courses)
Activity: Quiz and assignments **20 Marks**

ISE2: AICTE & UNESCO'S certificate course on Social Emotional Learning for Youth Waging Peace (SEL4YWP)- UNESCO **30 Marks**
Link:
https://www.framerspace.com/course/ywp?cid=5eaff2c239109c2c12ef8bd3

**Participants need to register themselves in the link https://docs.google.com/spreadsheets/d/1dECtZbAmcPhKKelSEimVv-hzPV7dA_g-Brty2rxC2vE/edit?usp=sharing, before accessing the course content.
Activity: Article Discussion, Quiz and Assignments **20 Marks**

Recommended Books:

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics-Concepts and cases, Wadsworth Thompson Learning, United States,2005.
4. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
5. R S Naagarazan, A textbook on professional ethics and human values, New Age International (P) limited,New Delhi,2006.
6. http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		--	--	4	--	--	2	2
25CEP12CS01	Community Engagement Project	Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	50	--	50	--	100	

Pre-requisite Course Codes		--
Course Outcomes	CO1	Identify and address community needs and challenges which help learners to develop problem-solving skills and creativity in finding innovative solutions.
	CO2	Enhance their cultural competence and ability to work effectively in multicultural settings
	CO3	Critically think on complex issues considering multiple view points
	CO4	Demonstrate collaboration, team work, civic engagement, empathy and compassion while engaging directly with community
	CO5	Develop a lifelong commitment to social justice and making a positive impact in the world

This course requires students to participate in field-based learning/projects generally under the supervision of faculty. The curricular component of 'community engagement and service' involve activities that would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems.

At the end of the course, it is expected that students will have valuable learnings in terms of enhanced communication skills, increased cultural competence, improved critical thinking, leadership skills, collaboration skills, empathy & compassion, civic engagement, problem-solving skills, self-reflection & personal growth and long-term commitment to social justice.

It is expected that 26-30 hours of contact time per credit in a semester (52 to 60 hours in a semester for 2 credits) along with 13-15 hours of activities such as preparation for community engagement and service, preparation of reports, etc., and independent reading and study.

Other Guidelines to students for successful Community Engagement:

Community engagement is the process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people It is a powerful vehicle for bringing about environmental and behavioral changes that will improve the health of the community and its members. It often involves partnerships and coalitions that help mobilize resources and influence systems, change relationships among partners, and serve as catalysts for changing policies, programs, and practices.

Community engagement project is different as compared to traditional consultation. It is a regular engagement of community for achieving an identified goal or vision. It recognizes the role of community engagement in its broadest sense in the development of local democracy, while

noting that the focus of the report is on the practice of community engagement as it relates to local authority activity.

Communication, diplomacy, patience, and flexibility are essential to engage with a community. For a successful engagement conditions include: Shared and defined purpose. Willingness to collaborate. Commitment to contributing. Participation of the right people. Open and credible process. Involvement of a champion with credibility and clout. Ensure that the engagement process is complex but manageable. Initially the team will: Discuss and define the initiative and its potential impact. Set the purpose and goals for community engagement. Define the community. Know and respect the community's characteristics. Develop a relationship with the community, build trust, work with formal and informal leadership, find the community gatekeeper, identify the project champion, meet with the local organizations, and learn the assets and challenges for that community. Find the common interests.

The following four phases provide broad outline for the community engagement process:

Phase-I: Outreach

Go to the community instead of having the community come to you. Invite the stakeholders to a conversation. Create a constructive environment for dialogue allowing time to get to know the participants remembering that the community's time is valuable and must be respected. Identify the person or the organization that has convened the group and will provide initial leadership and organizational management. Outline the purpose and process for the conversation. Use a facilitator when appropriate. Define the issue and why it is important. Outline what is broken and focus on what is working. Is the issue a people problem or a situation problem? Can the problem be solved with technical expertise or will it require something else? Determine the interest and merit in hosting future discussions.

Phase-II: Gather Facts, Brainstorm and Select

Create an environment for discussion where people are comfortable asking questions, expressing doubts, and brainstorming new ideas. Gather the facts related to the issue and its impact. Use a SWOT, appreciative inquire, asset mapping, and other tools during the factfinding stage. Clarify the issue's alignment with the community's values and ethics. Establish the common ground on which conversations will be based. Brainstorm and gather alternative solutions. Ask the "what if" questions. Spend time discussing the options and the potential impact. Allow the process to equip the participants to see the change, feel the change, and then be prepared to change. Select the best practice/solution. If required use decision-making tools to reduce the number of options.

Phase-III: Plan and Review

Write the implementation action plan. Include the evaluation procedure that will answer the question "What will it look like when the change has happened?". Discuss the proposal with the appropriate stakeholders searching for insight and response. Use the feedback to assess and revise the plan. Stay focused on the solution.

Phase-IV: Implement and Evaluate

Implement the plan. Remember, groups want a rapid success. Identify an action that will provide a "meaningful win" within the "immediate reach." Evaluate the impact. Report the status to the community and gather feedback. Revise the plan and evaluate again.

Keep the participants informed through discussion agendas, written summaries of previous discussions, goals/assignments for the next discussion, and progress reports providing accountability for delivering what was promised.

Course Assessment:

ISE1:

Activity: Report Submission: 20 Marks
Activity: Report Presentation: 30 Marks

ISE2:

Activity: Report Submission: 20 Marks
Activity: Report Presentation: 30 Marks

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25DM01/ 25HR01	Introduction to Emerging Technologies	2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	

Pre-requisite Course Codes		--
Course Outcomes	CO1	Recognize the dynamic nature of emerging technologies and their evolving landscape.
	CO2	Demonstrate knowledge of the key characteristics and potential applications of emerging technologies.
	CO3	Identify the value, innovative solutions or applications for real-world challenges using emerging technologies
	CO4	Analyze the implications of emerging technologies on society, business, and various industries
	CO5	Identify various emerging technologies relevant to his/her discipline for personal and professional growth
	CO6	Recognize the need for continuous learning to keep pace with technological advancements.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Introduction to Industrial Revolution, Important Inventions during various Industrial Revolutions (IR).	1,2	2
	1.2	Role of data, Enabling devices, Network and Human to Machine Interaction during IR	1,2	1
2	2.1	Data Science: Overview of data science, Data Science Life Cycle, Cloud Computing with examples of available Clouds, Big Data, Big data Life Cycle with Hadoop	1,2	3
	2.2	Artificial Intelligence and Machine Learning: Philosophy of AI, Components of AI, Important terminologies, AI Problem-Solving, Real-World AI, Types of Machine Learning, Neural Networks, Applications: Computer Vision, Robotics, NLP. Societal Implications of AI.	1,2	3
	2.3	Fundamentals of Blockchain, Blockchain applications and architecture. Introduction to Cyber Security, Cyber-attacks, and defences. Case studies.	1,2	3
	2.4	Robotic Process Automation, RPA Tools, and Applications	6	1
3	3.1	Internet of Things (IoT): Introduction, IoT Sensors, IoT Data acquisition & platforms, IoT Data Communication, IoT data storage and Retrieval, IoT data analytics & visualization and IoT Security, IoT Product Development Life Cycle, Industrial IoT, Concept of Edge Computing. Case studies	1,2	3
	3.2	Introduction to Immersive Technologies (AR, VR and MR), AR /VR systems with IOT, AI and Haptics, Tools needed to build AR Apps, use cases, Human Centric UX design	3	2

4	**4.1**	Semiconductor and Nanotechnology: Evolution of Semiconductor Industry, Trends, and Innovations in Semiconductor Technologies with respect to material, devices, circuits, architecture, and applications. Indian Semiconductor Industry: present status, market trends, challenges, policy initiatives by Government of India	4	3
	4.2	Digital Manufacturing, Principles of 3D Printing, Classification and material used in 3D printing, software tools and applications to various fields. Introduction to Robotics, Drones and Autonomous Systems. Fundamentals of tools, software and hardware required to build robot and autonomous systems. Applications and Case studies.	1,6	3
	4.3	Other Trends in emerging technologies: 5G telecom networks and Electric Vehicles	6	2
			Total	**26**

Course Assessment:

Theory:

ISE1: Activity 1: Quiz: 20Marks
Activity 2: Article Discussion on applications, benefits, effects of emerging technologies. 20 Marks
Activity 3: Literature survey report writing on emerging technology application 10 marks
Learning Outcome: PO6: Engineer and Society
CO4: Analyze the implications of emerging technologies on society, business, and various industries
Industry Skill: Critical Thinking

ISE2: Activity 1: Quiz: 20 Marks
Activity 2: Group discussion on emerging technologies: 10 Marks
Activity 3: Real-world case studies or use cases where the technology is being applied. Examine success stories, failures, and lessons learned.20 Marks
Learning Outcome: PO12: Life Long Learning
CO6: Recognize the need for continuous learning to keep pace with technological advancements.
CO5: Identify various emerging technologies relevant to his/her discipline for personal and professional growth

Recommended Books:

1. Vasudha Tiwari. Sunil Kumar Chaudhary and Iqbal Ahmed Khan, "Emerging Technology for Engineers", Vayu Education of India, 1st Edition.
2. Chanagala Shankar, "Emerging Technologies", Bluerose Publishers Pvt. Ltd, 1st Edition

3. Chandradev Yadav, "The Evolution of Immersive Technologies: A Journey into the Extraordinary", 1st Edition
4. Website of India Semiconductor Mission (https://ism.gov.in/)
5. SWAYAM course on 'An Introduction to Artificial Intelligence'
6. Other relevant online resources to be used.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25BSC12CS06	Linear Algebra and Business Statistics	2	1	0	2	1	0	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Tutorial	20	--	30	--	50	

Pre-requisite Course Codes	Matrices and Differential Calculus, Integral Calculus and Probability Theory	
Course Outcomes	CO1	Demonstrate basic knowledge about the vector spaces as an algebraic structure.
	CO2	Able to optimize the given function using linear programming problems
	CO3	Able to optimize the given function using non-linear programming problems
	CO4	Apply the concept of Correlation and Regression to engineering problems in data science, machine learning, and AI.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Linear Algebra - Vector Spaces**	1,2	**06**
	1.1	Vector spaces		02
	1.2	Subspaces of vector spaces		02
	1.3	Basis and dimension		01
	1.4	The Gram-Schmidt orthogonalization process		01
2		**Linear programming Problems (LPP)**	3,4	**07**
	2.1	Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables, Simplex method.		03
	2.2	Artificial variables, Big-M method (Method of penalty)		02
	2.3	Duality, Dual of LPP and Dual Simplex Method		02
3		**Non-linear Programming Problems (NLPP)**	3,4	**06**
	3.1	NLPP with one equality constraint (two or three variables) Using the method of Lagrange's multipliers		02
	3.2	NLPP with two equality constraints		02
	3.3	NLPP within equality constraint: Kuhn-Tucker conditions		02
4		**Correlation and Regression**	5,6,7	**07**
	4.1	Karl Pearson's Coefficient of correlation(r) and related concepts with problems.		02
	4.2	Spearman's Rank correlation coefficient(R) (Repeated &non Repeate dranks problems)		01
	4.3	Lines of regression		02

	4.4	Introduction to multiple linear regression		02
			Total	**26**

Tutorial:

Exp.No.	Tutorial Details	Marks
1	Vector spaces and subspaces	06
2	Basis and dimension of a vector space	06
3	LPP: Simplex method and Big M method	08
4	LPP: Dual of LPP and dual simplex method	06
5	NLPP: Optimization with equality constraints	06
6	NLPP: Optimization with inequality constraints	06
7	Correlation	06
8	Regression	06
	Total Marks	**50**

Course Assessment:

Theory:

ISE-1: Quiz: 20 Marks
ISE-2: Quiz: 20 Marks
MSE: 30 Marks 90 minutes written examination based on 50% syllabus
ESE: 30 Marks 90 Minutes written examination based on remaining syllabus after MSE

Tutorial:

1. ISE-1 will be conducted for three tutorials. Continuous pre-defined rubrics-based evaluation for 20 marks.
2. ISE-2will be conducted for five tutorials. Continuous pre-defined rubrics-based evaluation for 30 marks.

Recommended Books:

1. Robert M. Thrall, Leonard Tornheim, "*Vector Spaces and Matrices*", Dover Publications, Inc.
2. Gilbert Strang, "*Linear Algebra for Everyone*", Wellesley Publisher.
3. Prem Kumar Gupta, D. S. Hira, "*Operations Research*", S. Chand and Company Limited, Reprint edition (2017).
4. Hamdy A. Taha, "*Operations Research: An Introduction*", Pearson/Prentice Hall Publisher, 6th edition.
5. Dr B.S. Grewal, "*Higher Engineering Mathematics*", Khanna Publications,4nd Edition.
6. H.K. Dass, "*Advanced Engineering Mathematics*", S. Chand,28th Edition.
7. Erwin Kreysizg, "*Advanced Engineering Mathematics*", John Wiley&Sons,10th Edition.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PCC12CS08	Computer Organization and Architecture	L	T	P	L	T	P	Total
		2	-	-	2	-	-	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE		Total
		Theory	20	30	20	30		100
		Practical	--	--	--	--		--

Pre-requisite Course Codes		Digital Electronics, Programming Fundamentals
Course Outcomes	Learners will be able to	
	CO1	Describe the basic structure of computer and compare architecture models.
	CO2	Implement algorithms for arithmetic operations.
	CO3	Comprehend processor architecture with various design methods of CPU.
	CO4	Classify different types of memory and implement various mapping techniques for cache and virtual memory.
	CO5	Describe I/O organization and analyze different parallel processing and pipelining concepts.
	CO6	Examine emerging trends in computer architecture.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Overview of Computer Organization and Architecture**	1	02
	1.1	Introduction of Computer Organization and Architecture, Basic organization of Computer and block level description of the functional units, Von Neumann model, Harvard model, Evolution of Intel processors.		
	1.2	Performance: Processor clock, basic performance equation, complier, performance measurement, Multiprocessor& Multicomputer, Multicore architecture.		
2		**Data Representation and Arithmetic Algorithms**	2,3	03
	2.1	Number representation: Floating point representation, floating point arithmetic, IEEE754floatingpoint number representation, Fast multiplication: Bit pair recording of multipliers		
	2.2	Booth's algorithm for signed multiplication, Restoring and Non-restoring Division		
3		**Processor Organization and Control Unit design**	1,2	06
	3.1	CPU Architecture, Register Organization, Instruction formats, basic instruction cycle, instruction interpretation and sequencing.		

		Case study of 8086 architecture and Register organization		
	3.2	Control unit: Micro programmed and Hardwired Control unit design methods, Microinstruction sequencing and execution, micro-operations		
	3.3	Introduction to RISC and CISC architectures and design issues.		
4		**Memory Organization**	1,2,4	06
	4.1	Memory Systems: Types of memory: RAM, ROM, Cache Memory hierarchy and its importance, Cache organization and principles, mapping techniques.		
	4.2	Virtual Memory: Paging and segmentation, Page tables and translation lookaside buffers (TLBs), Memory management unit (MMU), page replacement policies.		
5		**I/O Organization and Introduction to Parallel Processing**	1,2,4	07
	5.1	Buses: Synchronous, Asynchronous, Interface circuits: Parallel port, Serial port, Standard I/O Interfaces: PCI, SCSI, USB, CAN bus		
	5.2	Parallelism in Computer Architecture: Pipelining and its advantages, pipelining stages and pipelining hazards Superscalar and VLIW architectures, SIMD and MIMD architectures		
6		**Emerging Trends in Computer Architecture**	5,6,7	02
	6.1	Power efficiency and low-power design, Quantum computing basics. Neuro morphic computing and AI accelerators		
			Total	**26**

Course Assessment:

Theory:

ISE1: 20 Marks
Activity: Quiz (10 Marks) and assignments (10 Marks)

ISE2:20 Marks
Activity: Group Discussion on Benchmarking and Performance Evaluation, Influence of Computer Architecture on Software Development, Ethical Considerations in Computer Architecture, Security Implications in Computer Architecture, Parallel Processing in Real-world Applications, Impact of Cache Memory on System Performance: (10 Marks) Assignments (10 Marks)

MSE: 30 Marks 90 minutes written examination based on 50% syllabus
ESE: 30 Marks 90 Minutes written examination based on remaining syllabus after MSE

Recommended Books:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", TataMcGraw-Hill,5th Edition.
2. William Stallings, "Computer Organization and Architecture, Pearson,8th Edition.
3. Morris Mano, "Computer System Architecture", Pearson, 3rdEdition.
4. John P. Hayes, "Computer Architecture and Organization", Tata McGraw-Hill, 3rd Edition.
5. Yan Du, 'The Influence and Application of Computer Technology on Architectural Design", International conference on Network and Information systems for Computers, 2022.
6. Yoon Seok Yang, Yongtae Kim, "Recent Trend of Neuromorphic Computing hardware: Intel's Neuromorphic System Perspective", International SoC Design Conference,2020.
7. Mark Barnelli, Courtney Raymond, Lisa Loomis, Darrek Isereau, Daniel Brown, Francesca Vidal, Steven Smiley, "Advanced Ultra Low Power Deep Learning Applications with Neuromorphic Computing", High Performance Extreme Computing,2023

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25PCC12CS09	Database Management System	2	- -	2	2	--	1	3
		Examination Scheme						
			ISE	MSE	ISE	ESE		Total
		Theory	20	30	20	30		100
		Lab	20	--	30	--		50

Pre-requisite Course Codes		Programming Fundamentals,
Course Outcomes	CO1	Design ER/EER Model for real life applications and convert it into relational model
	CO2	Execute Relational Algebra operation to perform operation on database
	CO3	Implement SQL commands for given task
	CO4	Apply normalization to database design to remove redundancies
	CO5	Describe concurrency control mechanism to achieve serializability and deadlock Handling

Module No.	Unit No.	Topics	Ref.	Hrs
1		**Introduction**	1,2	2
	1.1	Introduction, Characteristics of databases, File system v/s Database system,		
	1.2	Data abstraction and data Independence, DBMS system architecture, Database Administrator		
2		**Entity–Relationship Data Model**	1,2	4
	2.1	The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation,		
	2.2	Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation		
	2.3	Introduction to the Relational Model, ER to relational model rules and problems, Case studies and practice problems		
3		**Relational Algebra**	1,2	4
	3.1	Introduction to relational query language, Role of Relational Algebra in DBMS, Relational Algebra operators and Queries, Conversion of Relational Algebra into SQL		
4		**Structured Query Language (SQL)**	1,2	4
	4.1	Overview of SQL, Data Definition Language Commands, key constraints, Domain Constraints		
	4.2	Data Manipulation commands, DQL, Aggregate function-group by, having, Views in SQL, joins, Nested and complex queries, Data Control commands, Set and string operations, Triggers, PLSQL		
5		**Relational-Database Design**	1,2	6

	5.1	Pitfalls in Relational-Database designs, Concept of normalization, Function Dependencies, First Normal Form, 2NF, 3NF, BCNF. Converting Relational Schema to higher normal form, Problems based on Normalization		
6		**Transactions Management, Concurrency and Recovery**	1	6
	6.1	Transaction concept, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, Serializability-Conflict and View, Problems based on Conflict and View Serializability, Concurrency Control: Lock-based, Timestamp-based protocols, Recovery System: Log based recovery, Deadlock handling		
			Total	**26**

Course Assessment:

Theory:

ISE1: Activity: Quiz / assignments on first three modules for 20 marks

ISE2: Activity: Quiz/Assignments/ Article discussion on next three modules for 20 marks

MSE: 30 Marks 90 minutes written examination based on 50% syllabus

ESE: 30 Marks 90 Minutes written examination based on remaining syllabus after MSE

Lab:

ISE1: will be conducted for five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks

ISE2: Rest five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks. Implementation of Mini project for 10 marks

Module No.	Exp. No.	Suggested List of experiments
1,2	1	Identify the case study and detail statement of problem. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model
1,2	2	Convert ER/EER model to relational model
4	3	Create and populate database using Data Definition Language (DDL) and DML Commands for the specified System without integrity constraint.
4	4	Create and populate database using Data Definition Language (DDL) and DML Commands for the specified System with integrity constraint
4	5	Perform Simple queries and Date operations
4	6	Perform Join operations and Complex queries
4	7	Perform nested sub-queries in SQL
4	8	To implement PL/SQL and Procedures and Functions
4	9	To implement Triggers and Cursors
6	10	To implement Transaction and Concurrency control
	11	Exposure to MongoDB
	12	Mini project for Real life Scenario

Recommended Books:

1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6thEdition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 5thEdition, Pearson Education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH
4. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management‖, Thomson Learning, 5thEdition.
5. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
6. G. K. Gupta, Database Management Systems, McGraw Hill, 2012

Online Resources:

1. https://www.db-book.com/db6/slide-dir/index.html-Korth, Slberchatz, Sudarshan, 6th Edition
2. http://www.tutorialspoint.com/sql/
3. https://www.w3schools.com/sql/default.asp
4. http://www.mysqltutorial.org/ or https://www.tutorialspoint.com/postgresql/
5. https://academy.vertabelo.com/course/standard-sql-functions#
6. www.postgresqltutorial.com/postgresql-grouping-sets/
7. www.postgresqltutorial.com
8. https://www.freeprojectz.com/entity-relationship-diagram
9. https://www.w3schools.com/sql/sql_any_all.asp
10. https://www.geeksforgeeks.org/sql-all-and-any/

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PCC12CS10	Data Analytics and Visualization	L	T	P	L	T	P	Total
		2	0	2	2	0	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Practical	20	--	30	--	50	

Pre-requisite Course Codes		Discrete Maths, Statistics
Course Outcomes	CO1	Execute exploratory data analysis on any structured data.
	CO2	Apply various analysis and visualization techniques using modern tools on real-world data
	CO3	Perform prediction by applying regression models
	CO4	Demonstrate advance understanding of Time series concepts and analysis
	CO5	Analyze Text data and gain insights.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction**	1,2	4
	1.1	Data Analytics Lifecycle overview: Key Roles for a Successful Analytics, Background and Overview of Data Analytics Lifecycle Project		
	1.2	Need of exploratory data analysis, Understand the Data, Data Collection, Data Cleaning, Data Transformation, Data Integration, Data Exploration, Data Summarization, Feature engineering, the Kinds of Data Analytics – Descriptive, Diagnostic, Predictive and Data Mining		
2		**Data Visualization**	2	4
	2.1	Principles of effective visualization, Benefits of Visualization. Types of visualizations: **Charts**: Bar charts, line charts, pie charts, etc. **Graphs**: Scatter plots, histograms, boxplot, word cloud etc. **Maps**: Geographic maps, heat maps etc. **Dashboards**: Interactive platforms that combine multiple visualizations. Data Visualization Tools: Excel, Tableau, Power BI		
3		**Regression**	2,5	6
	3.1	Introduction to simple Linear Regression: The Regression Equation, fitted value and Residuals, Least Square Method, Coefficient of Determination, Correlation Coefficient, Regression coefficient Introduction to Multiple Linear Regression: Assessing the Model, Cross-Validation, Model Selection and Stepwise Regression, Prediction Using Regression		

	3.2	Logistic Regression: Logistic Response function and logit, Logistic Regression and GLM, Generalized Linear model, predicted values from Logistic Regression, Interpreting the coefficients and odds ratios, Linear and Logistic Regression: similarities and Differences, Assessing the models.		
4		**Time Series Analysis and Prediction**	1,3	6
	4.1	Overview of Time Series Analysis, Components of time series, decomposition of time series, methods of finding trend, methods of finding seasonal variation, Additive model, Multiplicative model, Box-Jenkins Methodology		
	4.2	Autoregressive Models, Moving Average Models, ARMA and ARIMA Models, SARIMA models, Autocorrelation Function, Partial autocorrelation function (ACF, PACF), Building and Evaluating an ARIMA Model,		
5		**Text Analytics**	1,4	6
	5.1	History of text mining, Roots of text mining, overview of seven practices of text analytic, Application and use cases for Text mining: extracting meaning from unstructured text, Summarizing Text.		
	5.2	Text Analysis Steps, A Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency—Inverse Document Frequency (TFIDF), Categorizing Documents by Topics, Determining Sentiments, Gaining Insights.		
			Total	**26**

Course Assessment:

Theory:

ISE1: 20 Marks

Activity: Any two activities like quiz/ Assignments/crossword/ oral/case study on initial 50% syllabus

ISE2: 20 Marks

Activity: Any two activities like quiz/ Assignments/crossword/ oral/case study on remaining 50% syllabus

MSE: 30 Marks 90 minutes written examination based on 50% syllabus

ESE: 30 Marks 90 Minutes written examination based on remaining syllabus after MSE

Lab:

ISE1: 20 Marks

Evaluation based on first four Practical

ISE2: 30 Marks

20 marks evaluation based on next four practical, 10 marks for mini project

Module No.	Exp. No.	Suggested List of experiments
1	1	Install data analysis and visualization tools: python/ Tableau public/ power BI and Perform exploratory analysis on any real-world data using python
2	2	a. Implement data visualization using excel b. Implement data visualization in python

2	3	a. Performing Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, user interaction, etc., b. Build cartographic visualization for multiple datasets
2	4	Build interactive application (dashboard, storytelling etc.) using Tableau
3	5	a. Apply Linear regression to given data set b. Apply Logistic regression to given data set
4	6	Implement time series decomposition
4	7	Build a time-series model (ARIMA) on a given dataset and evaluate its accuracy
5	8	a. Perform text mining on a set of documents and visualize the most important words in a visualization such as word cloud. b. Implement TFIDF algorithm c. Perform text sentiment analysis
		Mini project: Use a case study on a data set and apply the various EDA and visualization techniques and present an analysis report

Recommended Books:

1. Wes McKinney, "Python for Data Analysis", 3rd Edition, Publisher(s): O'Reilly Media, Inc.
2. Bharati Motwani, "Data Analytics using Python", 2nd Edition, Wiley Publications
3. George Athanasopoulos, Rob J Hyndman, "Forecasting: Principles and Practice", 3rd Edition, Otext Publication
4. Dipanjan Sarkar, "Text Analytics with Python: A Practitioner's Guide to Natural Language Processing", 2ND EDITION, Apress publisher
5. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, "Statistics for Business and Economics"11th Edition, South-Western, Cengage Learning

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PCC12CS11	Competitive Coding Lab	L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes	Programming Fundamentals, Data structure, Analysis of algorithm	
Course Outcomes	CO1	Solve advanced array and string problems using efficient techniques like the sliding window and two-pointer approach.
	CO2	Develop expertise in utilizing linked lists, stacks, and queues to efficiently solve complex computational problems.
	CO3	Apply graph and tree algorithms to solve complex problems, enhancing data analysis and optimization efficiency.
	CO4	Implement efficient pattern-matching algorithms, optimizing performance through detailed complexity analysis.
	CO5	Apply bit manipulation, number theory, and modular arithmetic techniques to effectively solve real-world computational problems.

Exp. No.	Topics
1	**Complexity Classes & Algorithm Comparison:** Revise and compare algorithms based on the following time complexities: • O(1): Constant time - e.g., accessing an array element • O(log n): Logarithmic time - e.g., binary search • O(√n): Square root time - e.g., algorithms involving geometric operations • O(n): Linear time - e.g., linear search • O(n log n): Linearithmic time - e.g., merge sort, quick sort, heap sort • $O(n^2)$: Quadratic time - e.g., bubble sort, insertion sort • $O(n^3)$: Cubic time - e.g., 3D matrix operations • $O(2^n)$: Exponential time - e.g., brute-force for the Traveling Salesman Problem • O(n!): Factorial time - e.g., generating all permutations
2	**Advanced Standard Library Data Structures** Deepen your understanding of dynamic arrays, sets, maps, iterators, and range operations with real-world applications and optimization challenges: • **Dynamic Arrays:** Implement efficient resizing and compare performance across insertions and deletions. • **Sets & Maps:** Solve problems with custom comparisons, such as finding the top K elements or first unique character in a stream. • **Iterators & Range Operations:** Use iterators for merging sorted arrays or sliding window algorithms with range queries. • **Optimized Data Structures:** Implement custom map/set from scratch, optimizing for time and memory complexity.

	Lab Exercise: • Build an LRU cache with std::map for fast lookups. • Find the top K elements dynamically with maps and sets. • Solve the sliding window maximum problem with efficient complexity using range-based operations.
3	**Advanced Arrays and Strings:** Learn and apply techniques like the sliding window, two-pointer approach, and binary search to solve complex problems in arrays and strings. **Lab Exercises:** • Find the maximum sum sub-array of size K using the sliding window technique. • Find the longest substring without repeating characters. • Find a pair with a given sum in a sorted array using the two-pointer technique. • Search for an element in a rotated sorted array using binary search. • Check if there is a pair in an array with a given sum X using hashing. • Find the first missing positive integer in an unsorted array. • Solve the "Sort Colors" problem (0s, 1s, 2s problem) using the Dutch National Flag algorithm. • Solve two medium-level array problems on a competitive programming platform like LeetCode or Codeforces. • Find the maximum product of two integers in an array. • Find the longest increasing subsequence in an unsorted array. • Move all zeroes in an array to the end while maintaining the relative order of non-zero elements. **Advanced Learner Challenges:** • Count all palindromic substrings in a given string. • Find the minimum number of swaps required to make a string palindrome. • Solve the "Longest Palindromic Substring" problem using Manacher's algorithm. • Sort an array and count the number of inversions. • Find the median of two sorted arrays using binary search. • Solve the "Kth Largest Element in an Array" using the quick-select algorithm. • Find all unique triplets in an array that sum to zero. • Solve the "Container With Most Water" problem using the two-pointer approach. • Implement a solution for the "3Sum" problem using sorting and two-pointer technique. • Solve the "Maximum Subarray Sum" problem using dynamic programming (Kadane's algorithm).
4	**Linked List:** Study the fundamental operations and advanced techniques involving linked lists, including reversing, detecting loops, and rearranging nodes. **Lab Exercises:** • Reverse a linked list in groups of K. • Detect and remove a loop in a linked list.

	• Reorder a linked list, rearranging nodes in the pattern L1 → Ln → L2 → Ln-1 → L3 → Ln-2 → .... • Implement basic operations like insertion, deletion, and traversal in a singly linked list. • Find the middle element of a linked list using two pointers. • Merge two sorted linked lists into one sorted list. • Reverse a singly linked list using an iterative and recursive approach. • Detect if a linked list is a palindrome using two-pointer technique. • Find the intersection point of two linked lists using hash sets or two-pointer technique. • Rotate a linked list by k positions. **Advanced Learner Challenges:** • Flatten a multilevel doubly linked list (where each node may have a next and child pointer). • Find the intersection point of two linked lists using optimized space (no additional data structures). • Merge k sorted linked lists using a priority queue. • Detect and handle cycle in a linked list using the Floyd's cycle-finding algorithm (Tortoise and Hare). • Implement an LRU cache using doubly linked list and hash map. • Implement a doubly linked list and perform operations like insertion, deletion, and traversal.
5	**Stack and Queue:** Study the fundamental operations of stacks and queues, including their applications and efficient implementations. **Lab Exercises:** • Sort a stack using recursion. • Check for balanced parentheses using a stack. • Implement a circular queue using arrays or linked lists. • Generate binary numbers from 1 to N using a queue. • Implement a queue using two stacks. • Reverse a stack using recursion. • Implement a stack using linked list and perform basic operations. • Implement a queue using two stacks and perform enqueue and dequeue operations. • Solve the "Next Greater Element" problem using a stack. • Implement a queue that supports fast access to both the front and back elements. • Implement a priority queue using a heap data structure. **Advanced Learner Challenges:** • Implement a stack that supports retrieving the minimum element in O(1) time. • Evaluate Reverse Polish Notation (RPN) using a stack. • Design and implement an LRU (Least Recently Used) Cache with O(1) operations for both get and put. • Solve the "Sliding Window Maximum" problem using deque. • Implement a stack that supports O(1) time for both push and pop operations in a multi-threaded environment.

	• Design a queue that supports O(1) time complexity for enqueue and dequeue operations using a doubly linked list.
4	**Graphs:** Study essential graph algorithms including Topological Sorting, Maximum Flow, Maximum Bipartite Matching, Strongly Connected Components, and Cycle Detection using Union-Find. **Lab Exercises:** • Detect a cycle in a graph using Depth-First Search (DFS). • Find all connected components in an undirected graph using DFS/BFS. • Implement the Shortest Path algorithm in an unweighted graph. • Perform Topological Sorting on a Directed Acyclic Graph (DAG). • Solve the Word Ladder problem using BFS. • Check if a graph is bipartite using BFS/DFS. • Implement Dijkstra's algorithm for the shortest path in a weighted graph. • Find the shortest path in a graph using Bellman-Ford Algorithm. • Solve the Hamiltonian Path problem using backtracking. • Find the Articulation Points and Bridges in a graph. **Advanced Learner Challenges:** • Find all Strongly Connected Components (SCCs) in a directed graph using Tarjan's Algorithm. • Solve the Maximum Bipartite Matching problem using augmenting paths or Hopcroft-Karp algorithm. • Implement the Ford-Fulkerson Algorithm for Maximum Flow and use Edmonds-Karp for efficient implementation. • Solve graph colouring problems with greedy or backtracking algorithms. • Apply the Hungarian Algorithm to solve the assignment problem. • Implement Minimum Spanning Tree using Kruskal's or Prim's Algorithm.
5	**Trees: -** Study essential tree structures such as Binary Search Trees (BST), B-Trees, AVL Trees, Red-Black Trees, Segment Trees, and Binary Index Trees, with a focus on their construction, operations, and applications. • Binary Search Tree (BST): Insert a key into a Binary Search Tree (BST), search for a key, delete a node while maintaining properties, perform inorder, preorder, and postorder traversals, find the height, check if a binary tree is a valid BST, and find the Lowest Common Ancestor (LCA) of two nodes. • B-Trees and B+ Trees: Insert keys into a B-Tree while maintaining balance, delete keys ensuring validity, and traverse all keys in sorted order in a B+ Tree. • AVL Tree: Insert a node into an AVL Tree with rotations (LL, RR, LR, RL) and check if a binary tree is height-balanced. • Red-Black Tree: Insert a key into a Red-Black Tree while maintaining properties and check if a tree satisfies Red-Black Tree rules.

	• Segment Trees: Construct a segment tree for range sum queries, query the sum of a range [l, r], and update an index in the array with reflected changes in the segment tree. • Binary Index Tree (BIT): Build a Binary Index Tree for prefix sum queries, query the prefix sum up to a given index, and update an element reflecting changes in the BIT. Advanced Learner: (Fenwick Tree, LCA with Binary Lifting, Heavy Light decomposition). • Find the Maximum Value in a Range After K Range Updates (Lazy Propagation). • Dynamic Range Sum Queries Using Fenwick Tree. • LCA of Two Nodes Using Binary Lifting. • Path Queries in a Tree Using Heavy-Light Decomposition.
6	**Greedy Algorithms:** Study advanced interval scheduling problems and complex optimization problems using greedy techniques. **Lab Exercises:** • Implement Huffman coding for data compression. • Solve the Activity Selection Problem to choose the maximum number of compatible activities. • Find the minimum number of coins required to make a given amount (Coin Change Problem). • Solve the Gas Station Problem to determine the starting point for a circular route with fuel constraints. • Solve the Fractional Knapsack Problem to maximize the total value of items in a knapsack. • Solve the Jump Game problem to determine if it's possible to reach the last index of an array. • Find the minimum number of platforms required for trains, given their arrival and departure times. • Solve the Job Sequencing Problem to schedule jobs with deadlines and maximize profit. • Maximize the sum of selected intervals by finding non-overlapping intervals. • Solve the interval covering problem to select the smallest number of intervals covering a given range. **Advanced Learner Challenges:** • Use Prim's Algorithm to find the minimum cost to connect all points in a graph (Minimum Spanning Tree). • Split an array into M subarrays to minimize the largest sum using binary search and greedy methods. • Construct the Lexicographically smallest string after K swaps. • Maximize the number of non-overlapping subarrays with a given sum using greedy algorithms. • Solve the Min-Cost to Connect All Points problem using a greedy approach and MST. • Solve the Minimum Cost to Hire K Workers problem with constraints.

	• Maximize the total weight of intervals in an interval scheduling problem with additional constraints.
7	**Dynamic Programming:** Explore foundational and advanced concepts, including the Travelling Salesman Problem (TSP), Longest Arithmetic Subsequence, and various Matrix DP problems. **Lab Exercises:** • Solve the Fibonacci sequence using recursion and dynamic programming. • Implement Matrix Chain Multiplication to minimize multiplication costs. • Find the Longest Increasing Subsequence in a given array. • Solve the 0/1 Knapsack Problem using DP. • Determine if an array can be partitioned into two subsets with equal sums (Partition Equal Subset Sum). • Find the number of unique paths in an m x n grid (robot grid path problem). • Solve the Longest Common Subsequence (LCS) problem for two strings. • Compute the Edit Distance (minimum operations to convert one string to another). • Solve the Coin Change problem to find the minimum number of coins needed to make a sum. **Advanced Learner Challenges:** • Compute the Maximum Path Sum in a Binary Tree using dynamic programming. • Solve the Travelling Salesman Problem (TSP) using bit masking and DP. • Find the minimum number of insertions to make a string a palindrome. • Count the number of ways to partition a set into K subsets using Stirling Numbers. • Solve the Maximum Rectangle in a Binary Matrix problem. • Find the minimum cost path in a weighted grid using DP. • Implement Word Break Problem using a dictionary and DP.
8	**Bit Manipulation:** Master the use of bitwise operators and their applications, including subset generation, XOR tricks, subset sum with bit masking, and counting set bits. **Lab Exercises:** • Find the only non-repeating number in an array using XOR. • Compute the maximum XOR of two numbers in an array. • Count the number of set bits (1s) in an integer using bitwise operations. • Generate all subsets of a set using bit masking. • Solve the problem of checking if a number is a power of two using bit manipulation. **Advanced Learner Challenges:** • Reverse the bits of a given number. • Check if a number is a power of two using bitwise tricks. • Find the number of ways to partition a set using XOR. • Solve the Travelling Salesman Problem (TSP) using bit masking and dynamic programming.

9	**Strings and Pattern Matching:** Explore key algorithms for string matching, including Rabin-Karp, Z-Algorithm, and Knuth-Morris-Pratt (KMP). **Lab Exercises:** • Find the longest palindromic substring in a given string. • Implement the KMP pattern matching algorithm to search for a pattern in a text. • Find all occurrences of a pattern in a text using the Rabin-Karp algorithm. • Find the smallest window in a string that contains all characters of another string. **Advanced Learner Challenges:** • Compute the Longest Prefix which is also a Suffix (LPS Array) for a string. • Find the shortest string that contains all permutations of another string. • Generate all palindromic substrings of a string efficiently. • Implement the Z-Algorithm for pattern matching in a string.
10	**Mathematics and Number Theory:** Explore fundamental concepts in number theory, including the Chinese Remainder Theorem, tiling problems, modular arithmetic, and key algorithms such as GCD, LCM, prime factorization, and combinatorics. **Lab Exercises:** • Find the number of ways to tile a floor of size NxM using 1xM tiles. • Find the Kth smallest number in lexicographical order. • Count the number of distinct subsequence's of a string using modular arithmetic. • Solve modular arithmetic problems using basic number theory operations (GCD, LCM). **Advanced Learner Challenges:** • Use the Sieve of Eratosthenes to find all prime numbers less than N and explore its variants. • Apply the Chinese Remainder Theorem to solve modular congruence's and related problems.

Course Assessment:

ISE1: 20 marks evaluation based on first five experiments, with continuous rubric-based assessment

ISE2: 20 marks evaluation based on first five experiments, with continuous rubric-based assessment.

A 2-hour coding contest with two problems of varying difficulty levels, conducted on any online platform (10 marks).

Recommended Books:

1. The Algorithm Design Manual by Steven S. Skiena
2. Competitive Programmer's Handbook by Antti Laaksonen
3. Elements of Programming Interviews by Adnan Aziz (for interview-focused problem-solving)

Online Practice Platforms:

- Video tutorials on competitive programming (YouTube channels like Abdul Bari, CodeChef)
- GitHub - Competitive Programming
- **Codeforces**: For high-level algorithmic challenges
- **LeetCode**: For interview-specific questions
- **HackerRank**: For implementation-heavy challenges
- **TopCoder**: For advanced contests and problems
- **CodeChef**: For practicing competitive programming problems and contests
- **AtCoder**: For practicing algorithmic problems with increasing difficulty
- **SPOJ**: For a wide variety of algorithmic challenges

Online Certification Courses:

- *Udemy - The Bible of Competitive Programming & Coding Interviews*
- *Coursera - Data Structures and Algorithm Specialization by UC San Diego*

Additional Practice:

- **Linked Lists**: Problems on LeetCode (Linked List), GeeksforGeeks (Linked List Practice)
- **Stacks**: Problems on GeeksforGeeks (Stacks), HackerRank (Stacks)
- **Queues**: Practice on HackerRank (Queues), LeetCode (Queue Problems)
- **Trees**: Explore Binary Tree problems on LeetCode, GeeksforGeeks (Binary Trees)
- **Graphs**: Problems on Codeforces (Graphs), LeetCode (Graph Problems), GeeksforGeeks (Graph Algorithms)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25OE021	Emerging Technology and Law	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		--
Course Outcomes	CO1	To recognize the importance of legal technology domain
	CO2	To demonstrate awareness of the laws related to emerging technologies and legal implications of their work
	CO3	To demonstrate understanding of the impact of emerging/contemporary technologies on the legal ecosystem
	CO4	To demonstrate awareness about company laws, FEMA and few other important acts related to engineering design and consumer protection

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Tech Legal Market**	1	4
	1.1	Legal Marketplace, Impact of Technology on Legal Profession		
	1.2	How technologists can help reshape legal system		
	1.3	Career Development in Legal Tech Domain		
2		**Emerging Technologies and Legal Implications-1**	1	8
	2.1	Cyber Crimes, Cyber Threats, and Issues: Information Technology Act 2000		
	2.2	Blockchain and Legal Issues		
	2.3	Legal Implications of Artificial Intelligence		
	2.4	Electronic and Digital Signatures		
	2.5	Implications of social media Laws		
3		**Emerging Technologies and Legal Implications-2**	1	6
	3.1	Legal Ecosystem for Autonomous Vehicles and Unmanned Aerial Vehicles (UAV)		
	3.2	Privacy and Data Protection with a Trillion Connected & Cognitive Devices		
	3.3	Legal Ecosystem for 5G		
4		**Company Laws**	2,3	4
	4.1	Companies Act, 1956- Nature and Meaning, Classification of Companies, Incorporation of Companies		
	4.2	Sources of Capital, Board of Directors, Company Meetings		
5		**Regulation and Management of Foreign Exchange**	2,3	4
	5.1	Foreign Exchange Management Act FEMA 1999		
6		**Other Important Laws**		
	6.1	Consumer Protection Act, Competition Act 2002, Semiconductor Integrated Circuits Layout-Design Act 2000, Designs Act 2000, Bureau of Indian Standards Act 2016,		
			Total	**26**

Course Assessment:

ISE1: Quiz: 20 Marks
Activity: Negotiation: 30 Marks

ISE2: Quiz: 20 Marks
Activity: Moot Court: 30 Marks

Recommended Books:

1. N. S. Nappinai, "*Technology Laws Decoded*," LexisNexis, 2017
2. Vibha Arora and Kunwar Arora, "*Law for Engineers*" Central Law Publications, 2017
3. Vandana Bhatt and Pinky Vyas, "*Laws for Engineers*", ProCare, 2015

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25OE022	Principles of Management	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes	--	
Course Outcomes	After completing the given assignments and experiments, students will be able to:	
	CO1	Understand the evolution of management theories and their relevance today
	CO2	Apply planning tools and techniques to real-world business scenarios
	CO3	Understand effective organizational structures based on business requirements
	CO4	Study different leadership styles and apply appropriate leadership techniques in various situations.
	CO5	Recognize ethical dilemmas in management and apply responsible decision-making frameworks.
	CO6	Study critical thinking and problem-solving techniques to organizational issues.

Module No.	Topics	Ref.	Hrs
1	**Introduction to Management** Definition and Nature of Management: Understanding management as a process and its significance in organizations. Historical Evolution: Exploration of classical management theories, including contributions from Henri Fayol and Frederick Taylor. Managerial Roles and Skills: Analysis of the roles managers play and the skills required at different managerial levels.	1-5	04
2	**Planning** Strategic and Tactical Planning: Differentiating between long-term strategic planning and short-term tactical planning. Decision-Making Processes: Tools and techniques for effective managerial decision-making. Goal Setting and Management by Objectives (MBO): Establishing clear objectives and aligning them with organizational goals	4-7	05
3	**Organizing** Organizational Structure and Design: Examining various organizational structures and their impact on efficiency.	4-7	04

	Delegation and Authority: Understanding the distribution of authority and responsibility within an organization. Coordination and Communication: Strategies for effective internal communication and coordination among departments.		
4	**Leading** Leadership Theories and Styles: Study of different leadership models and their applicability. Motivation Techniques: Exploring theories of motivation and their implementation in the workplace. Team Dynamics and Group Behaviour: Insights into managing teams and understanding group behaviour.	5-7	05
5	**Control Systems and Processes** Establishing standards and monitoring performance. Financial Controls: Budgeting, financial reporting, and variance analysis. Quality Management: Introduction to quality control techniques and continuous improvement processes.	5-7	04
6	**Contemporary Issues in Management** Ethics and Social Responsibility: The role of ethics in managerial decisions and corporate social responsibility. Globalization and Management: Challenges and strategies in managing international operations. Innovation and Change Management: Managing organizational change and fostering innovation.	5-7	04
		TOTAL	**26**

Course Assessment:

ISE1: Quiz based on Module 1,2 and 3 (20 Marks)
Case study / Application with PPT Presentation (Group of 4 students) of Decision-Making Process Approach, MBO (30 Marks)

ISE2: Quiz based on Module 4,5 and 6 (20 Marks)
Case Study / Application / Research Literature Studies with PPT Presentation (Group of 4 students) on Leadership in Organization, Innovation and Change Management, continuous improvement processes (30 Marks)

Note: ISE will be based on Continuous predefined rubrics-based evaluation

Recommended Books:

1. Koontz, H., & Weihrich, H. (2010). Essentials of Management: An International Perspective (8th ed.). McGraw-Hill Education.
2. Robbins, S. P., & Coulter, M. (2017). Management (13th ed.). Pearson Education.
3. Daft, R. L. (2018). Management (13th ed.). Cengage Learning.
4. Stoner, J. A. F., Freeman, R. E., & Gilbert, D. R. (1995). Management (6th ed.). Prentice Hall.
5. Drucker, P. F. (2006). The Practice of Management. HarperBusiness.
6. Academy of Management Journal – Provides peer-reviewed research articles on management theory and practices.
7. Journal of Management Studies – Features cutting-edge research in all fields of management.

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25VSE12CS03	Web Programming	L	T	P	L	T	P	Total
		--	--	4	--	--	2	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	50	--	50	--	100	

Pre-requisite Course Codes		
Course Outcomes	CO1	Apply JavaScript, HTML5 and CSS3 effectively to create interactive and dynamic websites.
	CO2	Construct responsive websites using Bootstrap.
	CO3	Implement client-side scripting using JavaScript.
	CO4	Construct website using React as front end and node.js/express.js as back end.
	CO5	Construct web site using Java Server Pages and Java Beans.
	CO6	Implement Model View Controller architecture using Struts/Spring/FLUX

Sr. No.	Suggested List of Experiment
1	**Web Programming Fundamentals:** Web application architectures. New elements of HTML5- Image, Links, table, Form, List, Semantic Elements, audio, video, drag-drop, geo location, canvas. Develop static web page using HTML5 tags.
2	**Cascading Style Sheets:** CSS3 Syntax, Inclusion, Color, Background, Fonts, Tables, Lists, CSS3 selectors, Pseudo classes and Pseudo elements. Apply the Cascading Style Sheet to the html web page
3	**Bootstrap:** Bootstrap Grid System, Forms, Button, Navbar, Dropdowns and Responsive Tabs, Breadcrumb, Jumbotron. Construct responsive website using Bootstrap.
4	**JavaScript:** Variables, Operators, Conditions, Loops, Functions, Events, , Error handling, Validations, Built-in Objects Arrays, String , Date, Document Object Model(DOM) Objects, ECMAEcripts-ES5,ES6,ES7,ES8, Iterators, Classes and Objects, Arrow Function, Promises Apply JavaScript to make the webpage interactive.
5	**React:** JSX, Components, Props, State, Forms, Events, Routers, Refs, Keys, Effects, Hooks, Flow Architecture Design a web page React JS.
6	**Node.js and Express.js:**

	Asynchronous Programming, Callback concept, Callbacks, Event Loops, Event Emitter, Networking module, Express Router, REST API, Authentication, Integrating with React Create website with Node.JS/Express.
7	**Java EE application:** Introduction to JSP-Servlet-Enterprise Java Beans,Stateful and stateless Session beans, JNDI, Message-driven beans, JDBC Database Connectivity Implement Server-side programming using JSP and JavaBeans.
8	**MVC Framework:** Model View Controller-FLUX, Struts or Spring, Bundling the application, Web Pack, Mini web application with MVC architecture Spring/Struts/FLUX

Course Assessment:

ISE1:

Evaluation of first four experiments for 40 marks. Oral/ practical test 10 marks

ISE2:

Evaluation of remaining experiments for 30 marks and Project Competition/Hackathon/mini project (with at least one innovative feature): 20 marks

Recommended Books:

1. Christopher Schmitt, Kyle Simpson, "HTML5 Cookbook", O'Reilly Media
2. Eric Meyer, "CSS Pocket Reference, 5th Edition", O'Reilly Media, Inc., 2018
3. Venkat Subramaniam, "Rediscovering JavaScript, Master ES6, ES7, and ES8", 2018
4. Alex Banks and Eve Porcello, "Learning React Functional Web Development with React and Redux", O'Reilly
5. Andrew Mead, "Learning Node.js Development", Packt Publishing
6. Juha Hinkula, "Full Stack Development with Spring Boot and React -Third Edition", Packt Publishing
7. "Beginning JSP 2.0, Build Web Applications using JSP, Java, Struts", Wrox Publications
8. Ed Roman, Rima Patel Sriganesh, Gerald Brose, "Mastering Enterprise JavaBeans", Wiley Publications

Online Courses:

1. https://www.coursera.org/learn/html-css-javascript-for-web-developers?action=enroll
2. https://onlinecourses.swayam2.ac.in/ugc19_lb05/preview
3. https://reactjs.org/tutorial/tutorial.html
4. https://react-redux.js.org/introduction/quick-start
5. https://webpack.js.org/
6. https://www.oracle.com/java/technologies/jee-tutorials.html
7. https://getbootstrap.com/docs/5.2/getting-started/introduction/

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25EEM12CS02	Technology Entrepreneurship	L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		--
Course Outcomes	CO1	Identify problems worth solving
	CO2	Craft value proposition
	CO3	Prepare B-Plan
	CO4	Register virtual company

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Opportunity Discovery**	1	6
	1.1	Self-discovery		
	1.2	Effectuation Principle		
	1.3	Identification of problem worth solving		
	1.4	Looking for solutions		
	1.5	Present the problem		
2		**Value Proposition Canvas and Business Model**	2,3	7
	2.1	Craft your value proposition		
	2.2	Presentation of Value Proposition Canvas		
	2.3	Business Model and Lean Approach(Finance, Marketing, Operations)		
	2.4	Presentation of Lean Canvas		
3		**Business Plan**	4	6
	3.1	Creation of Business Plan, Introduction to Minimum Viable product (MVP)		
4		**Company Formation**	5	7
	4.1	Promoters, Capital, Shareholders		
	4.2	Directors, DIN		
	4.3	Company Name, Registrations		
	4.4	Branding		
			Total	**26**

Course Assessment:

ISE1:
Quiz: 10 Marks
Assignment: Effectuation case study: 10Marks
Activity: Presentation of Value Proposition Canvas: 30 Marks Rubric Based assessment
ISE2:
Quiz: 10 Marks

Assignment: Presentation of Lean Canvas: 10Marks
Activity: Virtual Company registration: 30 Marks Rubric Based assessment

Recommended Books:

1. Sarasvathym "Elements of Entrepreneurial Expertise (New Horizons in Entrepreneurship Series)" Edward Elgar Publishing.
2. Alexander Osterwalder "Business Model Generation :A Handbook for Visionaries, Game Changers, and Challengers"
3. Alex Osterwalder, Yves Pigneur, Greg Bernarda, Alan Smith, Trish Papadakos "Value Proposition Design: How to create Products and Services Customers Want"
4. Garrett Sutton "Writing Winning Business Plans"
5. M.C. Bhandari "Company Law Procedures" LexiNexis, 2018

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25VEC12CS02	Technology Innovation for Sustainable Development	L	T	P	L	T	P	Total
		1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	40	--	60	--	100	

Pre-requisite Course Codes		--
Course Outcomes	CO1	Demonstrate a broad and coherent knowledge of United Nations Sustainable Development Goals (SDGs)
	CO2	Build the vocabulary and develop a nuanced understanding of the SDG themes: people, planet, prosperity, peace and partnership
	CO3	Identify technological solutions to address challenges of SDGs
	CO4	Build the vision to explain how to create a technological solution for sustainability

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**What are SDGs**	1,2,3	3
	1.1	Concept of Sustainability. The Role of UN and the Need for SDGs. Why SDGs are important.		
	1.2	Introduction to 17 SDGs		
2		**People Theme**	4,5	4
	2.1	Sustainable development goals 1-5		
	2.2	Technological Solutions to advance people theme		
3		**Planet Theme**		6
	3.1	Sustainable development goals 6, 12-15	4,5	
	3.2	Technological Solutions to advance planet theme		
4		**Prosperity Theme**		7
	4.1	Sustainable development goals 7-11		
	4.2	Technological Solutions to advance prosperity theme		
5		**Peace Theme**	4,5	3
	5.1	Sustainable development goal 16		
	5.2	Technological Solutions to advance peace theme		
6		**Partnership Theme**	4,5	3
	4.1	Sustainable development goals 17		
	4.2	Technological Solutions to advance partnership theme		
			Total	**26**

Course Assessment:

ISE1: Initial project presentation (20 Marks)
Activity: Creation of short movie (20 Marks)

ISE2: Poster making competition (20 marks)
Final project presentation (30 marks) Report Writing (10 marks)

Recommended Books:

1. https://sdgs.un.org/goals
2. https://sdgs.un.org/tfm
3. Himanshu Sharma, Tina Sobti"An Introduction to Sustainable Development Goals" 2018
4. Henrik SkaugSætra "Technology and Sustainable Development" Routledge, 2023
5. Sinan Kufeoglu "Emerging Technologies: Value Creation for Sustainable Development", Springer International Publishing, 2022