Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CEC401	Applied Mathematics-IV	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
CEC401	Applied Mathematics-IV	20	20	60	--	--	100

Pre- requisite: Knowledge of

1. FEC101- Applied Mathematics-I
2. FEC102- Applied Mathematics-II
3. CEC301- Applied Mathematics-III

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solution
4. PO4: Conduct Investigations of Complex Problems

Course Objectives:

1. To evaluate eigenvalues and eigenvectors and apply them to solve systems of linear equations and matrix diagonalization.
2. To evaluate line and contour integrals and construct the power series expansion of a complex-valued function.
3. To understand the concepts of probability distributions and sampling theory for small samples.
4. To apply the sampling theory on small dataset for analysis.
5. To understand the concepts of non-parametric and analysis of variance for testing.
6. To optimize the Linear and Non-linear programming problems.

Course Outcomes:

After successful completion of the course student will be able to

1. Evaluate eigenvalues and eigenvectors, analyze their properties, and apply them in engineering problem-solving.
2. Apply the concepts of Complex Integration to evaluate integrals, analyze and compute residues, and solve various contour integrals.
3. Design conclusions on population-based data science problems and interpret the hypotheses.
4. Analyze nonparametric test and perform Analysis of Variance on the population to analyze data.
5. Apply the concept of optimization on Linear Programming Problems.
6. Examine Non-Linear Programming Problems to engineering problems of optimization.

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0		**Linear Algebra (Theory of Matrices)**	**06**	
	1.1	Characteristic Equation, Eigenvalues and Eigenvectors, and properties (without proof). Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials.		**CO1**
	1.2	Similarity of matrices, diagonalizable and non-diagonalizable matrices.		
	1.3	Functions of Square Matrix, Derogatory and non-derogatory matrices.		
		Self-learning Topics: Coding and encoding of matrices		
2.0		**Complex Integration**	**07**	
	2.1	Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof).		**CO2**
	2.2	Taylor's and Laurent's series (without proof).		
	2.3	Definition of Singularity, Zeroes, poles of f(z), Residues, Cauchy's Residue Theorem (without proof).		
		Self-learning Topics: Application of Residue Theorem to evaluate real integrations		
3.0		**Probability Distribution and Sampling Theory**	**07**	
	3.1	Probability Distribution: Poisson and Normal distribution.		**CO3**
	3.2	Sampling distribution, Testing of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom.		
	3.3	Large Sampling with test of single mean and difference of means.		
	3.4	Students't-distribution (Small sample). Test the significance of mean and Difference between the means of two samples.		
		Self-learning Topics: Large sampling with testing for parameters.		
4.0		**Test of Hypothesis- Chi square Distribution and ANOVA**	**07**	
	4.1	Chi-Square Test: Test of goodness of fit.		**CO4**
	4.2	Independence of attributes, Contingency table.		
	4.3	Analysis of Variance (F-Test): One way classification, Two-way classification (short-cut method).		
		Self-learning Topics: Other types of non-parametric tests.		
5.0		**Linear Programming Problems**	**06**	
	5.1	Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables, Simplex method.		**CO5**
	5.2	Artificial variables, Big-M method (Method of penalty).		
	5.3	Dual Simplex Method.		
		Self-learning Topics: Principle of Duality, Dual of LPP.		
6.0		**Nonlinear Programming Problems**	**06**	

	6.1	NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers.		**CO6**
	6.2	NLPP with **One** inequality constraint: Kuhn-Tucker conditions.		
	6.3	NLPP with two inequality constraint: Kuhn-Tucker conditions.		
		Self-learning Topics: NLPP with two equality constraints.		
		Total	**39**	

Textbooks:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication, 45th edition.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, 10th Edition 2023-24.
3. Higher Engineering Mathematics: B V Ramna; Tata McGraw Hill Publication
4. Fundamentals of Mathematical Statistics – S. C. Gupta & V. K. Kapoor, 12th edition, 2020.

Reference books:

1. **Matrices** – Shanti Narayan, S. Chand Publications, Revised edition.
2. Foundations of Complex Analysis, S. Ponnusamy, Narosa Publications.
3. **Advanced Engineering Mathematics** – H. K. Dass, S. Chand Publications, 2007.
4. J. K. Sharma, "Operation Research", S. Chand Publications, 6th edition 2017.
5. T. Veerarjan, "Engineering Mathematics", Tata McGraw Hill Publication 2007.

Online References:

Course on Advanced Engineering Mathematics

1. https://nptel.ac.in/courses
2. https://www.coursera.org/courses?query=advanced%20engineering%20mathematics

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 50% syllabus)

End Semester Examination:

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CEC402	Operating System	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
CEC402	Operating System	20	20	60	--	--	100

Pre- requisite:
1. CEC305- Computer Organization and Architecture

Program Outcomes Addressed
1. PO1: Engineering Knowledge
2. PO2: Problem Analysis

Course Objectives:
1. To understand the basic concepts of Operating System, its functions and services.
2. To introduce the concept of a process and its management like transition, scheduling, etc.
3. To understand basic concepts related to Inter-process Communication (IPC) like mutual exclusion, deadlock, etc. and role of an Operating System in IPC.
4. To understand the concepts and implementation of memory management policies and virtual memory.
5. To understand the functions of Operating System for storage management and device management.
6. To study the need and fundamentals of special-purpose operating system with the advent of new emerging technologies.

Course Outcomes: Upon completion of this course, learners will be able to…
1. Identify the importance of operating system, its functions and services.
2. Compare process scheduling algorithms to ensure efficient execution of processes.
3. Apply concept of process synchronization and deadlocks.
4. Analyse memory management algorithms in effective allocation of main memory usage.
5. Discuss various File management methods and analyse I/O management algorithms for performance and quality criterion.
6. Compare the functions of various special-purpose Operating Systems.

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0		**Operating system Overview**	**03**	
	1.1	Introduction, Objectives, Functions and Evolution of Operating System		**CO1**
	1.2	Operating system structures: Layered, Monolithic and Microkernel		
	1.3	Linux Kernel, Shell and System Calls		
		Self-learning Topics: Resource Manager view, process view, Virtual Machine.		
2.0		**Process Management and Scheduling**	**07**	
	2.1	**Process:** Basic Concepts of Process; Process State Model and Transition; Operation on Process; Process Control Block, Context switching		**CO2**
	2.2	**Threads:** Introduction to Threads; Types of Threads		
	2.3	**Uniprocessor Scheduling:** Basic Concepts of Scheduling; Types of Schedulers scheduling algorithms.		
		Self-learning Topics: Multithreading Models, Thread libraries, Performance comparison of Scheduling Algorithms		
3.0		**Process Synchronization and Deadlock**	**10**	
	3.1	**Process Synchronization:** Basic Concepts of Inter-process Communication and Synchronization; Race Condition; Critical Region and Problem; Peterson's Solution; Synchronization Hardware and Semaphores; Classic Problems of Synchronization; Message Passing		**CO3**
	3.2	**Deadlocks Management**: System Model, Deadlock Characterization; Deadlock Detection and Recovery; Deadlock Prevention; Deadlock Avoidance.		
		Self-learning Topics: Barber's shop problem , real time case study for Deadlock detection and recovery		
4.0		**Memory Management**	**09**	
	4.1	**Memory Management:** Basic Concepts of Memory Management; Swapping; Contiguous Memory Allocation; Paging; Structure of Page Table; Segmentation.		**CO4**
	4.2	**Virtual Memory:** Basic Concepts of Virtual Memory; Demand Paging, Copy-on Write; Page Replacement Algorithms; Thrashing		
		Self-learning Topics: Concept of memory management in Linux & Windows NT/XP		
5.0		**File and I/O Management**	**06**	
	5.1	**File Management:** Basic Concepts of File System; File Access Methods; Directory Structure; File-System Implementation; Allocation Methods; Free Space Management; Overview of Mass-Storage Structure		**CO5**
	5.2	**I/O Management:** I/O devices, Organization of the I/O Function, Disk Organization, I/O Management and Disk Scheduling: FCFS, SSTF,		

		SCAN, CSCAN, LOOK, C-LOOK.		
		Self-learning Topics: NTFS File system, RAID structure		
6.0		**Operating Systems Security**	**04**	
	6.1	**Overview of Security and Protection:** Goals of Security and Protection, Security and Protection Threats.		**CO6**
	6.2	**Protection Structure:** Granularity of Protection, Access control Matrix, Access Control Lists (ACLs), Capability Lists(C-Lists), Protection Domain		
		Self-learning Topics: Classification of Computer Security, Security Attacks.		
		Total	**39**	

Textbooks:

1. A.Silberschatz, P. Galvin, G. Gagne, Operating System Concepts, 10th ed., Wiley, 2018.
2. W. Stallings, Operating Systems: Internal and Design Principles, 9th ed., Pearson, 2018.
3. A. Tanenbaum, Modern Operating Systems, 4th ed., Pearson, 2015.
4. D. M. Dhamdhere, Operating Systems: A Concept-Based Approach, McGraw Hill, 2009.

Reference books:

1. Achyut Godbole and Atul Kahate, Operating Systems, 3rd ed., McGraw Hill Education, 2011.
2. N. Chauhan, Principles of Operating Systems, 1st ed., Oxford University Press, 2014.
3. A.Tanenbaum and A. Woodhull, Operating System Design and Implementation, 3rd ed., Pearson, 2006.
4. R. Arpaci-Dusseau and A. Arpaci-Dusseau, Operating Systems: Three Easy Pieces, 1st ed., CreateSpace Independent Publishing Platform, 2018.

Online References:

1. https://www.nptel.ac.in
2. https://archive.nptel.ac.in/courses/106/105/106105214/
3. https://archive.nptel.ac.in/courses/106/105/106105172/

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

SIES Graduate School of Technology
Department of Computer Engineering
Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CEC403	Analysis of Algorithm	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
CEC403	Analysis of Algorithm	20	20	60	--	--	100

Pre- requisite:
Basic knowledge of programming and data structure.

Program Outcomes Addressed
1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO4: Conduct Investigations of Complex Problems
4. PO8: Individual and Collaborative Teamwork
5. PO9: Communication
6. PO11: Life-Long Learning

Course Objectives:
1. To provide mathematical approaches for analysis of algorithms.
2. To understand and solve problems using various algorithmic approaches.
3. To analyze algorithms using various methods.
4. To develop a technique for analyzing and computing the performance of an algorithm.
5. To understand computational complexity classes and their significance in problem-solving.
6. To apply algorithmic techniques to solve real-world computational problems.

Course Outcomes:
After successful completion of the course, students will be able to:
1. Analyze the running time and space complexity of the algorithms.
2. Describe, apply, and analyze the complexity of the divide and conquer strategy.
3. Solve optimization problems using greedy strategy and analyze the complexity.
4. Illustrate and analyze the complexity of dynamic programming strategy.
5. Explain and apply backtracking, branch, and bound.
6. Apply string matching techniques and understand various complexity classes.

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0		**Introduction**	**07**	
	1.1	**Introduction:** Performance analysis, space and time complexity, Growth of function, Big-Oh, Omega Theta notation Mathematical background for algorithm analysis. Analysis of selection sort, insertion sort.		**CO1**
	1.2	**Recurrences:** The substitution method, Recursion tree method, Master method.		
		Self-learning Topics: Bubble Sort, Randomized Algorithms		
2.0		**Divide and Conquer Approach**	**06**	
	2.1	General method, Merge sort, Quicksort, Finding minimum and maximum algorithms and their Analysis, Analysis of Binary search		**CO2**
		Self-learning Topics: Implementation of Linear search, Strassen's Matrix Multiplication		
3.0		**Greedy Method Approach**	**06**	
	3.1	General Method, Single source shortest path: Dijkstra Algorithm, Fractional Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees: Kruskal and Prim's algorithms		**CO3**
		Self-learning Topics: Graph representations: adjacency matrix and adjacency list, Optimal storage on tape algorithm.		
4.0		**Dynamic Programming Approach**	**09**	
	4.1	General Method, Multistage graphs, Single source shortest path Bellma ford Algorithm, All pair shortest path: Floyd Warshall Algorithm, 0/1 knapsack Problem, Travelling Sales person problem, longest commo subsequence		**CO4**
		Self-learning Topics: Matrix operations, Assembly-line scheduling Problem		
5.0		**Back tracking and Branch and bound**	**06**	
	5.1	General Method, Backtracking: N-queen problem, Sum of subsets, Graph coloring.		**CO5**
	5.2	Branch and Bound: Travelling Sales person Problem,15 Puzzle problem		
		Self-learning Topics: Basics of graph theory and set theory, Hamiltonian cycle.		
6.0		**String Matching Algorithms**	**05**	
	6.1	The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm		**CO6**
	6.2	**Complexity class:** Definition of P, NP, NP-Hard, NP-Complete		
		Self-learning Topics: Modular arithmetic, Boyer Moore algorithm		
		Total	**39**	

Textbooks:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, PHI Publication, 2005.
2. Ellis Horowitz, Sartaj Sahni, and Sangu thevar Rajasekaran, Fundamentals of Computer Algorithms, 2nd Edition, Orient Black Swan, 2008.

Reference books:

1. Sanjoy Dasgupta, Christos Papadimitriou, and Umesh Vazirani, Algorithms, McGraw-Hill Education, 2006.
2. S. K. Basu, Design Methods and Analysis of Algorithms, PHI Learning Pvt. Ltd., 2005.

Online References:

1. https://nptel.ac.in/courses/106/106/106106131/
2. https://swayam.gov.in/nd1_noc19_cs47/preview
3. https://www.coursera.org/specializations/algorithms

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CEC404	Critical Thinking and Design	02	-	-	02	-	-	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
CEC404	Critical Thinking and Design	15	15	45	--	--	75

Pre- requisite: None

Program Outcomes Addressed

1. PO2: Problem Analysis
2. PO3: Design/Development of Solutions
3. PO5: Engineering Tool Usage
4. PO6: The Engineer and The World
5. PO7: Ethics
6. PO8: Individual and Collaborative Team Work
7. PO9: Communication
8. PO10: Project Management and Finance
9. PO11: Life-Long Learning

Course Objectives:

1. To describe the fundamentals of critical thinking and fair-minded reasoning for effective decision-making.
2. To differentiate personal thinking stages and implement structured strategies for continuous cognitive growth.
3. To analyze key elements of thought and intellectual standards to enhance logical reasoning.
4. To examine the principles of design thinking and apply them to solve real-world problems through an iterative, user-centered approach.
5. To demonstrate hands-on experience with idea generation, customer insights, and problem framing to drive innovation.
6. To employ creative problem-solving techniques such as brainstorming, prototyping, and hypothesis validation to design user-centric solutions.

Course Outcomes: Learners will be able to

1. Interpret the fundamentals of critical thinking and fair-minded reasoning for effective decision-making.
2. Identify their cognitive development stage and implement structured strategies to progress as a critical thinker.
3. Apply intellectual standards like clarity, accuracy, and logic to improve reasoning and problem-solving skills.
4. Integrate design thinking principles to create innovative, balanced, and user-centered solutions.
5. Develop a broad perspective in understanding customer needs and effectively define problem

statements using diverse methodologies.
6. Implement creative solutions and enhance ideas through iterative prototyping and user feedback using brainstorming techniques.

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0		**Introduction to Critical Thinking**	**04**	
	1.1	**Introduction:** Start-up definition of Critical Thinking how skilled are you as a Thinker? Hard Work, Concept of Critical Thinking, establish new habits of thoughts, Develop confidence		**CO1**
	1.2	**Fair-minded Thinker:** Weak Vs Strong Critical Thinking Requirement of Fair-mindedness Intellectual: Humility, Courage, Empathy, Integrity, Perseverance, Autonomy Interdependence of Intellectual Virtues		
		Self-learning Topics: Role of Intellectual Humility in Decision-Making		
2.0		**Four Stages of Development, Game Plan**	**03**	
	2.1	**Four Stages of Development:** Stage 1: Unreflective thinker, Stage 2: Challenged thinker, Stage 3: Beginning thinker, Stage 4: Practicing thinker		**CO2**
	2.2	**Game Plan:** Purpose & Key Components of Game Plan, Integrating of Game Plan Strategies		
		Self-learning Topics: Case Study: Explores how a student progresses through four stages using self-reflection& discipline.		
3.0		**Self-Understanding, Parts & Universal Standards**	**03**	
	3.1	**Three Distinctive Functions:** Recognize the Mind's Three Distinctive Functions; Special Relationship		**CO3**
	3.2	**Thoughts & Intellectual Standards:** Fundamental structures of thought, The elements of thought, Universal Intellectual Standards: Clarity, Accuracy, Precision, Relevance, Depth, Breadth, Logic, Significance, Fairness		
		Self-learning Topics: Recognizing biases and promoting ethical decision-making.		
4.0		**Design Thinking & its Key Tenets**	**05**	
	4.1	**Design Thinking Basics:** Traditional Model vs. Design Thinking, Five Stages: Inspire, Empathize, Define, Ideate, Prototype & Test Scale Thinking: Lean Thinking, Critical Thinking, Lateral Thinking, Design Thinking		**CO4**
	4.2	**Key Tenets:**Customer-Centric Approach, Thinking Beyond Products, Balancing Desirability, Feasibility & Viability, Broad & Compartmentalized Thinking, Visual Thinking & Hands-on Approach		
		Self-learning Topics: Case Study: How a global brand used design thinking to enhance customer experience and increase engagement.		

5.0		**Inspire, Empathize and Define**	**05**	
	5.1	**Generating & Broadening Ideas:** Creating Stretch Goals, Power of Metaphors & Widening Perspectives, Importance of Diversity in Ideation		**CO5**
	5.2	**Empathize & Define:** New Channels for Customer Insights, Deep Customer Empathy & Stakeholder Analysis, Leveraging Technology for Insights, Mind Mapping: Stakeholders, Journey Mapping, Problem Framing		
		Self-learning Topics: Case Study: How Airbnb used empathy mapping and customer insights to redefine its business model.		
6.0		**Ideate, Prototype and Test**	**06**	
	6.1	Ideate: Brainstorming & Hybrid Ideation Techniques, Challenging Assumptions & Breaking Patterns, Cross-Industry Inspiration (Analogous Design), Designing for Extreme Users & Ideation Triggers		**CO6**
	6.2	Prototype & Test: Rapid Prototyping & Hypothesis Validation, Storyboarding & Scenario Visualization, Collecting Feedback & Managing Failed Prototypes		
		Self-learning Topics: Case Study: Explore Apple's iterative prototyping process in designing user-friendly products.		
		Total	**26**	

Textbooks:

1. Richard Paul, Linda Elder, "Critical Thinking: Tools for Taking Charge of Your Learning and Your Life",Fourth Edition, 2022,Pearson Education
2. Pavan Soni, "Design Your Thinking: The Mindsets, Toolsets, and Skill Sets for Creative Problem-solving",2020, Penguin Random House India Private Limited

Reference books:

1. Roger L. Martin,"The Design of Business: Why Design Thinking is the Next Competitive Advantage",2009,Harvard Business Press
2. Richard Paul, Robert Niewoehner, Linda Elde,"The Thinker's Guide to Engineering Reasoning, 2019, Rowman & Littlefield Publishers, **ISBN-13:** 978-1538133798
3. Tilmann Lindberg, Christoph Meinel, Ralf Wagner, Christo, "Design Thinking: Creating a Culture of Innovation",Springer
4. Brooke Noel Moore & Richard Parker,"Critical Thinking"13th Edition,2020,McGraw-Hill Education.

Online References:

1. https://onlinecourses.nptel.ac.in/noc19_mg60/preview
2. https://onlinecourses.nptel.ac.in/noc20_de03/preview
3. https://onlinecourses.swayam2.ac.in/imb24_mg37/preview
4. https://www.coursera.org/learn/uva-darden-design-thinking-innovation

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 10 marks.
- ISE 15 marks = 05 marks for attendance + 10 marks for activities.

MSE:

- To be conducted as written examination for 15 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 2 hours are of 60 marks and scaled to 45.

1. Question paper will comprise of 3 questions.
2. Question1(15 marks): - Solve any 03 out of 04. All questions carry 05 marks each.
3. Question 2 (30 marks): - Solve any 03 out of 05. All questions carry 10 marks each.
4. Question3 (15 marks):- Solve any 03 out of 04. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDM C4021	Statistical Foundation for Data Science	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
MDM C4021	Statistical Foundation for Data Science	20	20	60	--	--	100

Pre- requisite: Knowledge of

1. CSC301- Applied Mathematics-III

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solution
4. PO4: Conduct Investigation of Complex Problems
5. PO11: Life-Long Learning

Course Objectives:

1. To build an intuitive understanding of Mathematics and relate it to Artificial Intelligence, Machine Learning and Data Science.
2. To provide a strong foundation for probabilistic and statistical analysis mostly used in varied applications in Engineering.
3. Tofocusonexploringthedatawiththehelpofgraphicalrepresentationanddrawingconclusions.
4. To explore optimization and dimensionality reduction techniques.

Course Outcomes:

After successful completion of the course student will be able to

1. Use linear algebra concepts to model, solve, and analyze real-world problems.
2. Apply probability distributions and sampling distributions to various business problems.
3. Select an appropriate graph representation for the given data.
4. Apply exploratory data analysis to some real datasets and provide interpretations via relevant visualization
5. Analyze various optimization techniques.
6. Describe Dimension Reduction Algorithms

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0		**Linear Algebra**	**05**	
	1.1	Vectors and Matrices, Solving Linear equations, The four Fundamental Subspaces, Eigen values and Eigen Vectors, The Singular Value Decomposition (SVD).		**CO1**
		Self-learning Topics: Applications of Eigenvalues and Eigenvectors in Machine Learning		
2.0		**Probability and Statistics**	**07**	
	2.1	Introduction, Random Variables and their probability Distribution, Random Sampling, Sample Characteristics and their Distributions, Chi-Square, t-, and F-Distributions: Exact Sampling Distributions, Sampling from a Bivariate Normal Distribution, The Central Limit Theorem.		**CO2**
		Self-learning Topics: Bayesian Statistics and its Applications		
3.0		**Introduction to Graphs**	**05**	
	3.1	Quantitative vs. Qualitative data, Types of Quantitative data: Continuous data, Discrete data, Types of Qualitative data: Categorical data, Binary data, Ordinary data, plotting data using Bar graph, Piechart, Histogram, Stem and Leaf plot, Dot plot, Scatter plot, Time-series graph, Exponential graph, Logarithmic graph, Trigonometric graph, Frequency distribution graph.		**CO3**
		Self-learning Topics: Graph-Based Data Structures in Python		
4.0		**Exploratory Data Analysis**	**08**	
	4.1	Need of exploratory data analysis, cleaning and preparing data, Feature engineering, Missing values, understanding dataset through various plots and graphs, draw conclusions, deciding appropriate machine learning models.		**CO4**
		Self-learning Topics: Handling Imbalanced Datasets in Machine Learning		
5.0		**Optimization Techniques**	**07**	
	5.1	Types of optimization-Constrained and Unconstrained optimization, Methods of Optimization-Numerical Optimization, Bracketing Methods-Bisection Method, False Position Method, Newton's Method, Steepest Descent Method, Penalty Function Method.		**CO5**
		Self-learning Topics: Hyperparameter Tuning in Machine Learning Models		
6.0		**Dimension Reduction Algorithm**	**07**	
	6.1	Introduction to Dimension Reduction Algorithms, Linear Dimensionality Reduction: Principal component analysis, Factor Analysis, Linear discriminant analysis.		**CO6**
	6.2	Non-Linear Dimensionality Reduction: Multidimensional Scaling, Isometric Feature Mapping. Minimal polynomial.		
		Self-learning Topics: Principal Component Analysis (PCA) vs.		

		Linear Discriminant Analysis (LDA)		
		Total	**39**	

Textbooks:

1. Linear Algebra for Everyone, Gilbert Strang, Wellesley-Cambridge Press, 2020.
2. An Introduction to Probability and Statistics, Vijay K. Rohatgi & A. K. Md. Ehsanes Saleh, Wiley, 3rd Edition, 2015.
3. An Introduction to Optimization, Edwin K. P. Chong & Stanislaw H. Zak, Wiley, 2nd Edition, 2004.
4. Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press, 2020.
5. Exploratory Data Analysis Using R,Pearson, Ronald K, CRC Press, 1st Edition, 2018.

Reference books:

1. Introduction to Linear Algebra – Gilbert Strang, Wellesley-Cambridge Press, 5th Edition, 2016.
2. Advanced Engineering Mathematics – Erwin Kreyszig, Wiley, 10th Edition, 2011.
3. Foundations of Machine Learning – Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, MIT Press, 2nd Edition, 2018.
4. Understanding Machine Learning: From Theory to Algorithms – Shai Shalev-Shwartz
5.
6. and Shai Ben-David, Cambridge University Press, 2014.
7. Mathematics and Programming for Machine Learning with R – William B. Claster, CRC Press, 1st Edition, 2020.

Online References:

1. https://math.mit.edu/gs/linearalgebra/
2. https://www.coursera.org/learn/probability-theory-statistics
3. https://nptel.ac.in/courses/111/105/111105090/
4. https://onlinecourses.nptel.ac.in/noc21_ma01/preview
5. https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDM C4031	Microprocessor and Microcontrollers	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
MDM C4031	Microprocessor and Microcontrollers	20	20	60	--	--	100

Pre- requisite:

1. Digital system design

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solution
4. PO4: Conduct Investigation of Complex Problems

Course Objectives:

1. To equip students with the fundamental knowledge and basic technical competence in the field of Microprocessors.
2. To emphasize instruction set and logic to build assembly language programs.
3. To prepare students for higher processor / Controller architectures.
4. To understand architecture of 8051 and ARM7 core.

Course Outcomes:

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

1. Describe core concepts of 8086 microprocessor.
2. Interpret the instructions of 8086 and write assembly and Mixed language programs.
3. Appraise the architecture of advanced processors
4. Describe core concepts of 8051 microcontroller.
5. Interpret the instructions of 8051 and write assembly language programs.
6. Appraise the architecture of advanced controllers.

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0		**The Intel Microprocessors 8086 Architecture**	**08**	
	1.1	8086 CPU Architecture, Functional Pin Diagram		**CO1**
	1.2	Programmer's Model		
	1.3	Memory Segmentation, Banking in 8086		
	1.4	Demultiplexing of Address/Data bus		
	1.5	Functioning of 8086 in Minimum mode and Maximum mode		
	1.6	Interrupt structure and its servicing		
		Self-learning Topics: Timing diagram of minimum and maximum mode		
2.0		**Instruction Set and Programming of 8086**	**05**	
	2.1	Addressing Modes, Instruction set		**CO2**
	2.2	Program related -Data Transfer Instructions, String Instructions, Logical Instructions, Arithmetic Instructions, Transfer of Control Instructions, Processor Control Instructions		
		Self-learning Topics: 8255,8259 ,8257		
3.0		**Pentium Processor**	**06**	
	3.1	Comparison of 8086 and Pentium, Pentium Architecture, Superscalar Operation, Integer &Floating-Point Pipeline Stages		**CO3**
	3.2	Branch Prediction Logic, Cache Organization, MESI Protocol		
		Self-learning Topics: 80386 Processor		
4.0		**8051 Microcontroller**	**08**	
	4.1	Comparison between Microprocessor and Microcontroller		**CO4**
	4.2	Features, architecture and pin configuration of 8051		
	4.3	CPU timing and machine cycle		
	4.4	Memory organization		
	4.5	Counters and timers		
	4.6	Interrupts		
	4.7	Serial data input and output		
		Self-learning Topics: Input output ports		
5.0		**8051 Assembly Language Programming and Interfacing**	**06**	
	5.1	Addressing modes, Instruction set		**CO5**
	5.2	Programs related to :arithmetic, logical, delay subroutine, input, output, timer, counters, port, serial communication, and interrupts Interfacing with LEDs		
		Self-learning Topics: Need of Assembler & Cross Assemble, Assembler Directives		
6.0		**ARM7**	**06**	
	6.1	Introduction & Features of ARM 7, Concept of Cortex-A, Cortex-R		**CO6**

		and Cortex-M Architectural inheritance, Pipelining Programmer's model		
	6.2	Brief introduction to exceptions and interrupts handling Instruction set: Data processing, Data Transfer, Control flow		
		Self-learning Topics: Programming of ARM7		
		Total	**39**	

Textbooks:

1. K. M. Bhurchandani and A. K. Ray, "Advanced Microprocessors and Peripherals", McGraw Hill
2. Douglas V Hall, SSSP Rao "Microprocessors & Interfacing", McGraw Hill
3. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "The 8051 Microcontroller & Embedded systems", Pearson Publications
4. C. Kenneth J. Ayala and D. V. Gadre, "The 8051 Microcontroller & Embedded system using assembly & 'C' ", Cengage Learning
5. Steve Furber, "ARM System on chip Architecture", Pearson

Reference books:

1. John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", PH

Online References:

1. https://swayam.gov.in/nd1_noc20_ee11/preview
2. https://nptel.ac.in/courses/108/105/108105102/
3. https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894
4. https://www.mooc-list.com/tags/microprocessors

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
MDM C4061	Cost Management	03	-	-	03	-	-	03

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE$			
		ISE	MSE				
MDM C4061	Cost Management	20	20	60	--	--	100

Pre- requisite:

1. Basic Accounting principles, Quantitative skills etc.

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO11: Life-Long Learning

Course Objectives:

1. To acquire knowledge and understanding of the concepts, techniques, and practices of cost and management accounting and to develop skills for decision making.

Course Outcomes: Learners will be able to

1. To understand and analyze different cost concept and methods.
2. To understand the Elements of Cost & Cost classification.
3. To apply various material concepts & classifications for preparation of cost sheet.
4. To analyze various techniques of costing and its application in Finance, budgets and budgetary control.
5. To develop requisite data for cost control and cost reduction.
6. To evaluate marginal costing techniques for decision making.

Module No.	Unit No.	Topics	Hrs.	Mapped to Course Outcome
1.0	**1**	**Module 1: Introduction to Cost Accounting**	**04**	
		Meaning of Cost, Cost Accounting & its Objectives, Comparison between Cost accounting and Financial Accounting, Comparison between Cost Accounting and Management Accounting, Types of cost, Methods of costing & Techniques of costing.		**CO1**
		Self-learning Topics: Basic accounting concepts, Journal entry and ledgers.		
2.0	**2**	**Classification of Costs and Cost Sheet**	**05**	
		Elements of Cost, Classification of Costs, Cost center and cost unit, Preparation of Cost Sheet & Estimated Cost Sheet.		**CO2**
		Self-learning Topics: Purpose and importance of cost sheet.		
3.0		**Material Management and Accounting for materials**	**06**	
		Managing Purchase Functions, Cost of Material, Storing of materials – Inventory control methods, Costs associated with storing and ordering material, Economic Order Quantity, Fixation of levels and calculation of the same, Issue control-Pricing issues (LIFO, FIFO, Weighted Average), Material control -Objectives in Material Control, Stock Turnover, Material losses wastage, scrap, spoilage, defectives.		**CO3**
		Self-learning Topics: Basic flowchart for material flow in a company.		
4.0		**Accounting for labour and Overheads**	**08**	
		Accounting for labour: Types of Labour Cost, Methods of Remuneration, Treatment of overtime, fringe benefits, idle time etc. Accounting for overheads: Production overheads – Collection, Distribution to Production and service departments, Computation of Overheads Rate based on Machine Hour Rate method, Allocations and Apportionment, Absorption of overheads.		**CO4**
		Self-learning Topics: Types of labour, classification of overheads.		
5.0		**Cost Control and Cost Reduction**	**10**	
		Introduction, Comparison between cost control & cost reduction, Budgets and Budgetary Control, Meaning and Purpose of Budget, Objectives of Budgetary Control, Dangers of budget, Types of Budgets- Flexible Budget Standard Costing, Concept and development of standard costing,Variance analysis for cost, Direct Material variance- Cost, Price, usage, mix and yield variance Direct Labour Variance- Cost, Efficiency, usage, mix, yield and idle-time variance, Overhead Variance – Variable & Fixed Overhead variance, Sales variances – Value, rate, volume and mix variance.		**CO5**
		Self-learning Topics: Differences and Interplay Between Cost Control and Cost Reduction.		
6.0		Marginal Costing & CVP Analysis	**06**	

		Nature and scope of Marginal Costing, Marginal Cost equation, Cost Profit volume analysis, Break Even point and Break-Even Analysis, Relevant cost analysis for decision making.		**CO6**
		Self-learning Topics: Applications of Marginal Costing in Decision Making.		
		Total	**39**	

Textbooks:

1. B. Banerjee, Cost Accounting: Theory and Practice, 14th ed. New Delhi, India: PHI Learning Pvt. Ltd., 2021.
2. M. Y. Khan and P. K. Jain, Management Accounting, 8th ed. New Delhi, India: McGraw-Hill Education, 2021

Reference books:

1. P. Shah, Management Accounting, 6th ed. New Delhi, India: Oxford University Press, 2015.
2. C. Drury, Management and Cost Accounting, 12th ed. Andover, U.K.: Cengage Learning, 2024.

Online References:

1. https://dynamicstudyhub.com/cost-management.
2. https://www.wallstreetmojo.com/cost-management

Course Assessment:

ISE:

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

MSE:

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

End Semester Examination:

$ ESE of duration 03 hours are of 80 marks and scaled to 60.

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CEL401	Operating System Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
CEL401	Operating System Lab	--	--	--	25	25	50

Pre- requisite:

1. Knowledge on Operating system principles.

Program Outcomes addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct Investigations of Complex Problems
5. PO5: Engineering Tool Usage
6. PO8: Individual And Collaborative Team Work
7. PO9: Communication

Lab Objectives:

1. To gain practical experience with designing and implementing concepts of operating systems such as system calls, CPU scheduling, process management, memory management, file systems and deadlock handling using C language in Linux environment.
2. To familiarize students with the architecture of Linux OS.
3. To provide necessary skills for developing and debugging programs in Linux environment.
4. To learn programmatically to implement simple operation system mechanisms.

Course Outcomes:

Upon completion of this course, learners will be able to…

1. Illustrate basic Operating system Commands, Shell scripts, System Calls.
2. Simulate and implement various processes, scheduling algorithms and evaluate their performance.
3. Analyze and experiment various methods of synchronization and deadlocks.
4. Show various Memory Management techniques and evaluate their performance.
5. Illustrate and analyze concepts of virtual memory.
6. Implement and analyze concepts of file management and I/O management techniques.

Suggested List of Experiments			
Sr. No.		**Content**	**LO**
1		**Explore Linux Commands**	**LO1**
	1.1	Explore usage of basic Linux Commands and system calls for file, directory and process management. For eg:(mkdir, chdir, cat, ls, chown, chmod, chgrp, ps. System calls: open, read, write, close, get pid, set pid, get uid, get gid, get e gid, get euid. sort.)	
	1.2	Implement any one basic commands of linux like ls, cp, mv and others using kernel APIs.	
2		**Linux shell script**	**LO1**
	2.1	To write shell script a. Write a grep/egrep script to find the number of words character, words and lines in a file. b. Write an awk script to develop a Fibonacci series. c. Write an awk script to display the pattern of given string or number. d. Write an egrep script to display list of files in directory	
	2.2	Write shell scripts to do the following: a. Display OS version, release number, kernel version b. Display top10 processes in descending order c. Display processes with highest memory usage. d. Display current logged in user and logname. e. Display current shell, home directory, operating system type, current path setting, current working directory.	
3		**Linux-Process**	**LO1**
	3.1	a. Create a child process in Linux using the fork system call. From the child process obtain the process ID of both child and parent by using get pid and get ppid system call. b. Explore wait and wait pid before termination of process.	
4		**Process Management: Scheduling**	**LO2**
	4.1	a. Write a program to demonstrate the concept of non-preemptive scheduling algorithms. b. Write a program to demonstrate the concept of preemptive scheduling algorithms	
5		**CPU-OS simulator**	**LO2**
	5.1	Using the **CPU-OS simulator** analyze and synthesize the following: a. Process Scheduling algorithms. b. Thread creation and synchronization. c. Deadlock prevention and avoidance.	
6		**Process Management: Synchronization**	**LO3**
	6.1	Write a C program to implement solution of Producer consume problem through Semaphore	
7		**Process Management: Deadlock**	**LO3**
	7.1	a. Write a program to demonstrate the concept of deadlock avoidance through	

		Banker's Algorithm b. Write a program demonstrate the concept of Dining Philospher's Problem	
8		**Memory Management**	**LO4**
	8.1	a. Write a program to demonstrate the concept of MVT and MFT memory management techniques b. Write a program to demonstrate the concept of dynamic partitioning placement algorithms i.e. Best Fit, First Fit, Worst-Fit etc.	
9		**Memory Management: Virtual Memory**	**LO5**
	9.1	a. Write a program to demonstrate the concept of demand paging for simulation of Virtual Memory implementation b. Write a program in C demonstrate the concept of page replacement policies for handling page faults eg: FIFO, LRU etc.	
10		**File Management & I/O Management**	**LO6**
	10.1	a. Write a C program to simulate File allocation strategies typically sequential, indexed and linked files b. Write a C program to simulate file organization of multi-level directory structure. c. Write a program into do disk scheduling-FCFS,SCAN, C-SCAN	

Textbooks:

1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014.
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9thEdition, 2016.
3. Linux Kernel Book, by Remy Card, Eric Dumas, Frank Mevel, Wiley India.
4. Unix Concepts and Applications, Sumitabha Das, McGraw Hill.

Reference books:

1. Practicing Hand Book for Operating System Laboratory by Sathish Kumar Ravichandran, Archana Sasi.
2. Operating System Lab Programs: Guide to Shell and OS lab programs by S.Sydhani Begum
3. Maurice J. Bach, "Design of UNIX Operating System", PHI

Online References:

1. OS Simulator: Downloads – CPU-OS Simulator

Term Work will be assessed as **Continuous Internal Assessment Practical (CIAP).**

1. Term work should consist of 10 experiments covering all modules.
2. Journal must include at least 2 assignments on content of theory and practical of "Operating System"
3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)

Practical Exam: (2 hours/ 25 Marks)

End-semester Practical and oral exam will be held based on the above syllabus and will be assessed as **End Semester Examination Practical (ESEP).**

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CEL402	Analysis of Algorithm Lab	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
CEL402	Analysis of Algorithm Lab	--	--	--	25	25	50

Pre- requisite:

1. Basic knowledge of programming and data structure Lab

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO4: Conduct Investigations of Complex Problems
4. PO8: Individual And Collaborative Teamwork
5. PO9: Communication
6. PO11: Life-Long Learning

Lab Objectives:

1. To introduce the methods of designing and analyzing algorithms.
2. Design and implement efficient algorithms for a specified application.
3. Strengthen the ability to identify and apply a suitable algorithm for the given real-world problem.
4. Analyze the worst-case running time of algorithms and understand fundamental algorithmic problems.

Course Outcomes: Learners will be able to

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

1. Implement the algorithms using different approaches.
2. Analyze the complexities of various algorithms.
3. Compare the complexity of the algorithms for specific problems.
4. Apply appropriate algorithms to solve computational problems.
5. Implement advanced problem-solving techniques like backtracking and branch & bound.
6. Understand complexity classes through implementation and case studies.

Suggested List of Experiments

Star (*) marked experiments are compulsory.

Sr. No.	Title of Experiments	LO
1	A library management system needs to arrange books by their ID numbers in ascending order. Implement sorting techniques to efficiently organize the books.	LO1, LO2
2	Implementation of merge sort and quick sort.	LO1, LO2

3	A student records system allows users to search for a student's record by ID number. Implement an efficient search algorithm to find a student's details quickly.	LO1, LO3
4	A GPS navigation system needs to provide users with the shortest path between their current location and a given destination. Implement Dijkstra's algorithm to compute the optimal route.	LO1, LO3
5	Implementation of Prim's Algorithm for Minimum Spanning Tree (MST).	LO1, LO4
6	Implementation of the 0/1 Knapsack Problem using Dynamic Programming.	LO1, LO3
7	Implementation of the Floyd-Warshall algorithm all-pair shortest path.	LO1, LO3
8	A DNA sequencing research project aims to find the longest common subsequence between two DNA strands. Implement an LCS algorithm to compare genetic sequences efficiently.	LO1, LO4
9	A chess tournament system is testing possible arrangements of N queens on an N×N board such that no two queens attack each other. Implement the N-Queens problem using backtracking to generate valid placements.	LO1, LO5
10	Implementation of the Rabin- Karp String Matching Algorithm.	LO1, LO4
11	A university needs to schedule exams such that no two exams for the same student are scheduled at the same time. Implement the graph coloring algorithm to minimize the number of time slots required.	LO1, LO5
12	Write a case study on Complexity Classes: P, NP, NP-Hard, NP-Complete.	LO6

Textbooks:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, PHI Publication, 2005.
2. Ellis Horowitz, Sartaj Sahni, and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, 2nd Edition, Orient BlackSwan, 2008.

Reference books:

1. Sanjoy Dasgupta, Christos Papadimitriou, and Umesh Vazirani, Algorithms, McGraw-Hill Education, 2006.
2. S. K. Basu, *Design Methods and Analysis of Algorithms*, PHI Learning Pvt. Ltd., 2005.

Online References:

1. https://nptel.ac.in/courses/106/106/106106131/
2. https://swayam.gov.in/nd1_noc19_cs47/preview
3. https://www.coursera.org/specializations/algorithms

Term Work:

The term work should include 10 experiments. At least 02 assignments covering the entire syllabus must be given on the content of theory of "Analysis of Algorithms". The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

Term work Marks:

- 25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05

Marks (Attendance)

- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

Practical Exam: (2 hours/ 25 Marks)

- End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CEL403	Skill Lab (Web Technology)	--	2*+2	--	--	02	-	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
CEL403	Skill Lab (Web Technology)	--	--	--	25	25	50

Pre- requisite:

1. Basic knowledge of programming and data structure Lab

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO4: Conduct Investigations of Complex Problems
4. PO8: Individual And Collaborative Team Work
5. PO9: Communication
6. PO11: Life-Long Learning

Lab Objectives:

1. To introduce the methods of designing and analyzing algorithms.
2. Design and implement efficient algorithms for a specified application.
3. Strengthen the ability to identify and apply a suitable algorithm for the given real-world problem.
4. Analyzeworst-caserunningtimeofalgorithmsandunderstandfundamentalalgorithmicproblems.

Course Outcomes: Learners will be able to

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

1. Implement the algorithms using different approaches.
2. Analyze the complexities of various algorithms.
3. Compare the complexity of the algorithms for specific problems.
4. Use appropriate algorithms to solve computational problems
5. Implement advanced problem-solving techniques like backtracking and branch & bound
6. Understanding complexity classes through implementation and case studies.

Module		Detailed Content	Hours	LO mapped
1.0		**Foundations of Web Development with Git**	6	**LO1 LO2**
	1.1	WWW, Basic Internet Protocols, HTTP request and HTTP response message, HTML – Introduction, history and versions.		
	1.2	HTML elements: headings, paragraphs, line break, colors and fonts, links, frames, lists, tables, images and forms, Logical and physical tags in HTML5		
	1.3	Concept of **CSS**, Creating Style Sheet, CSS Properties, CSS Styling 4 (Background, Text Format, Controlling Fonts), Working with block elements and objects, Lists and Tables, CSS Id and Class, Box Model(Introduction, Border properties, Padding Properties, Margin properties) CSS Advanced: (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector). **Basics of Bootstrap**: The Grid System, CSS Foundations, Navigation Systems, JavaScript Effects		
	1.4	Introduction to Git and Github, Benefits of using Github, Pushing the source code into github, Collaborating with others by creating Pull Requests ,Working on parallel branches		
		Self-Learning topic: Create a game using HTML, CSS and Javascript where random shapes (circle, squares, rectangles) of random sizes and random color will appear and disappear on the screen for random time durations (0.5 sec to 3 sec). Clicking on the shape before it disappears will increment your score.		
2.0		**Javascript with AJAX**	**4**	**LO3**
	2.1	Introduction to JavaScript, DOM Manipulation, Data types, Values, Variables, Expressions and Operators, Statements, Objects, Arrays, Functions, Pattern matching with regular expressions, JavaScript in Web Browsers, The Window object, Scripting Documents, Scripting CSS, Handling Events		
	2.2	Introduction to AJAX, AJAX Components, AJAX with Javascript, AJAX with JQuery, AJAX and JSON,AJAX with Forms and API Integration		
		Self-Learning topic: Implement a search bar with live suggestions (like Google Search).		
3.0		**Back End Development**	**5**	**LO4**
	3.1	**Introduction** to PHP- Data types, control structures, built in functions, building web applications using PHP- Session handling Mechanisms, PHP and MySQL database connectivity .		
		Self-Learning topic:Build a webpage for Image or document file upload .		
4.0		**ReactJS (Frontend Layer for Full Stack Development)**	**5**	**LO5**
	4.1	**ReactJS**: Introduction, JSX, Components, Props, State, Hooks (use State, use Effect), React Router, Axios, VirtualDOM, API integration and Form Handling		
		Self-Learning topic: Simple React App like Random Joke Generator		
5.0		**MONGODB(Data Storage) and EXPRESS JS(Backend Layer for Full stack Development)**	**4**	**LO5**
	5.1	MongoDB: NoSQL basics, Collections/Documents, CRUD operations, Mongoose setup(ODM ie Object Data Modeling library), schema design.		

		Express.js(Node.js framework) : Building REST API , Routing, Middleware, MongoDB integration, JWT authentication, and backend for the React app.		
		Self-Learning topic: Web Application CRUD To-Do app.		
6.0		**Mini project**	**2**	**LO6**
	6.1	Selection of problem statements and implementing end to end solutions.		
		Total	26	

Textbooks:

1. Web Technology Black Book, Kogent Learning Sol., First Edition, Dreamtech Press, 2009
2. Ralph Moseley, M.T. Savliya , “Developing Web Applications”, Willy India, Second Edition.
3. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition,O'REILLY,2014
4. Professional Rich Internet Applications: AJAX and Beyond, Dana Moore, Raymond Budd,
   Edward Benson, Wiley publications First Edition.
5. Schwarz, D. (Year). *The Designer's Guide to Figma*. Perlego, First edition.
6. Alex Banks and Eve Porcello, Learning React Functional Web Development with React and Redux, O’Reilly, First Edition.
7. Krishna Chodorow, MongoDB The Definite Guide, O’Reilly, 2nd Edition.
8. Shelly Powers, Learning Node,O’Reilly, 2nd Edition.

Reference books:

1. Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, “Internet and World Wide Web - How To Program”, Fifth Edition, Pearson Education, 2011
2. Achyut S Godbole and Atul Kahate, “Web Technologies”, Second Edition, Tata McGraw Hill,2012.
3. Thomas A Powell, Fritz Schneider, “JavaScript: The Complete Reference”, Third Edition, TataMcGraw Hill, 2013.
4. Mike Mcgrath, “PHP & MySQL in easy Steps”, Tata McGraw Hill, 2012,Second Edition.
5. Masse, M. (2011). REST API Design Rulebook. Germany: O'Reilly Media,First Edition.
6. Steven Holzner —The Complete Reference - PHP, Tata McGraw Hill, 2008, First Edition.

Software Tools:

1. Figma Downloads | Web Design App for Desktops & Mobile

Online References:

1. Home | spoken-tutorial.org
2. Course: React JS for Web Development: React with Node JS, MongoDB | Udemy
3. W3Schools Online Web Tutorials

Suggested List of Programming Assignments / Laboratory Work:		
Sr.No.	**Name of the Experiment**	**LO mapped**
1	Installation of Git, Creating new GIT repository and understanding functionality like Add, ommit, Modify, View.	LO1
1	Develop a straightforward blog page using HTML, CSS, and Bootstrap. The blog page hould incorporate images, embedded videos, and a contact form.	LO2
2	Create a portfolio landing page using Html, CSS and JavaScript. Enhance it with features ke dark mode and light mode, and incorporate animations to elevate the website's aesthetic ppeal.	LO3
3	Design a static HTML page that contains a selection box with a list of 5 countries. When the ser selects a country, its capital should be printed next to the list. Add CSS to customize the roperties of the font of the capital (color, bold and font size).	LO3
4	Validate the fields of registration page created in the first experiment using regular xpressions in JavaScript and also Validate login credentials without refreshing the age.(AJAX and JSON).	LO3
5	Build a web page enabling users to retrieve and display real-time weather information for a pecific city using AJAX. Students should explore free API providers offering weather data.	LO3
6	Create interactive web pages that fetch, display, and update data from MySQL databases ynamically based on user interactions using PhP.	LO4
7	Create a react application and make use of at least 4 hooks available in react. (Eg: Simple ounter application in react which uses State Hooks).	LO5
8	Design and implement a basic CRUD (Create, Read, Update, Delete) operations system sing MongoDB.	LO5
9	A **blog platform** where users can create, edit, and delete posts, and view others' posts using xpress Js.	LO5
10	Mini Project based on the content of the syllabus (Group of 2-3 students).	LO6

Term Work(CIAP):

1. Term work should consist of 10 experiments and Journal submission.
2. Mini Project based on the content of the syllabus (Group of 2-3students).
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 – Marks (Experiments: 10 - marks, Attendance: 05 - marks, Mini Project:-5 marks, Participation or wining in Web based competition: 05-marks).

Practical Exam: (2 hours/ 25 Marks)

- End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CEL404	Value Education Course (UHV)	--	04	--	--	02	-	02

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
CEL404	Value Education Course (UHV)	--	--	--	50	--	50

Program Outcomes Addressed

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of
4. PO4: Investigation of Complex
5. PO5: Engineering Tool
6. PO6: The Engineer and The World
7. PO7: Ethics
8. PO8: Individual and Collaborative Team Work
9. PO9: Communication
10. PO10: Project Management and Finance
11. PO11: Lifelong Learning

Course Objectives:

1. **To introduce the fundamental concepts of human values**, including intrinsic and extrinsic values, and their relevance to personal and professional development in the context of IT engineering.
2. **To explore the principles of Universal Human Values (UHV)**, emphasizing self-awareness, self-exploration, and the application of tools like the JOHARI window and SWOT analysis in the IT profession.
3. **To study the different levels of harmony**—within oneself, in the family, society, and nature—and apply these concepts to achieve a balanced and fulfilling life, especially in the fast-paced IT industry.
4. **To comprehend the key aspects of professional ethics in IT**, including ethical standards, work ethics, and moral issues such as data privacy, cybersecurity, and AI ethics.
5. **To develop foundational values** such as integrity, impartiality, nonpartisanship, and objectivity, and cultivate empathy, tolerance, and compassion in both personal and professional contexts, particularly in IT-related decision-making.
6. **To integrate human values into IT practices**, focusing on ethical decision-making, sustainable technology development, and responsible innovation.

Course Outcomes: Learners will be able to

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

1. **Understand and Explain** (*Understand*) the basic concepts of human values and their significance in personal and professional contexts, particularly in the IT industry.
2. **Explore and Internalize** (*Apply*) human values to guide personal behavior and professional conduct in IT roles such as software development, data analysis, and cyber security.
3. **Analyze and Apply** (*Analyze & Apply*) the concept of harmony at various levels of existence to achieve a balanced life, even in high-pressure IT environments.
4. **Identify and Evaluate** (*Analyze & Evaluate*) ethical issues in the IT profession, including data privacy, cyber security, AI ethics, and intellectual property rights, using appropriate ethical theories and standards.
5. **Demonstrate and Uphold** (*Apply & Evaluate*) integrity and ethical principles in professional and public service contexts, fostering empathy and compassion in IT projects that impact society.
6. **Integrate and Implement** (*Create & Apply*) human values into IT practices, ensuring that technology development aligns with ethical, social, and environmental considerations.

Module No.	Unit No.	Topics	Mapped Learning Outcome (LO)
1.0		**Introduction to Human Values and Their Relevance in IT**	
	1.1	Definition, Intrinsic & Extrinsic values, Shalom Schwartz's Theory of Basic Human Values, Value education: Need, Basic Guidelines and Scope, Self-exploration, Happiness and Prosperity, Harmony, Self-awareness: JOHARI window and SWOT analysis	**LO1**
	1.2	Ethical Challenges in IT: Data privacy, cybersecurity, AI ethics, and intellectual property rights	**LO4**
2.0		**Understanding Human Beings and Harmony at Various Levels of Existence**	
	2.1	Human beings as a combination of the conscious 'I' and material body, Abraham Maslow's Hierarchy of Needs, Classification between I & Body, Co-existence, Harmony in Self: Swasthya and Sanyama	**LO3**
	2.2	Harmony in the Family -- Understanding Values in Human Relationships, Differentiation in relationships, Values in relationships	**LO3**
	2.3	Harmony in the Society -- From Family order to World Family Order, Comprehensive Human Goal, Harmony in Nature -- Understanding the Interconnectedness and Mutual Fulfilment, Understanding the Four Orders of Nature	**LO3, LO6**
3.0		Professional Ethics in IT	

Module No.	Unit No.	Topics	Mapped Learning Outcome (LO)
	3.1	Definition, Characteristics, Profession, Professionalism, Morality, Moral issues in the IT profession, Understanding Ethics, Ethical Standards, Work Ethics, Engineering Ethics	**LO4**
	3.2	Types of Inquiries, Kohlberg's Theory, Heinz Dilemma, Gilligan's Theory, and Ethical Theories	**LO4**
	3.3	Ethical Challenges in IT: Data privacy, cybersecurity, AI ethics, and intellectual property rights	**LO4**
4.0		**Ethics, Integrity, and Aptitude in IT**	
	4.1	Essence, determinants, and consequences of ethics in human actions, Dimensions of ethics, Ethics in private and public relationships	**LO5**
	4.2	Key contributions from Indian and global moral thinkers and philosophers, emphasizing integrity, impartiality, and non-partisanship in professional settings	**LO5**
	4.3	Upholding objectivity and dedication to public service, Cultivating empathy, tolerance, and compassion, with a focus on their application in IT and public welfare	**LO5**
5.0		**Understanding Harmony in Nature and Sustainable IT Practices**	
	5.1	Concept of harmony in Nature: Meaning of harmony in nature, Disharmony with Nature -- causes, Implications of disharmony with nature	**LO6**
	5.2	Maintaining harmony with nature: Harmony through mutual fulfilment of the four orders in nature, Harmony through symbiotic relationship with nature, Achieving competence in maintaining harmony with nature in professional life	**LO6**
	5.3	Sustainable IT Practices: Green computing, energy-efficient algorithms, and eco-friendly technology development	**LO6**
6.0		**Practicum Project -- Community Engagement and IT for Social Good**	
	6.1	Students carry out a community engagement project to benefit the local community through IT-based initiatives (e.g., developing apps for social causes, organizing digital literacy camps, or creating awareness about cybersecurity).	**LO2, LO5, LO6**
	6.2	Students write a reflective report on how the understanding of universal human values has been integrated into their IT project.	**LO5, LO6**

Textbooks:

1. **Naagarazan, R. S.** *A Textbook on Professional Ethics and Human Values*. 4th Edition. New Age International Publishers, 2021.
2. **Gaur, R.R., Sangal, R., &Bagaria, G.P.** *A Foundation Course in Human Values and Professional Ethics*. 3rd Edition. Excel Books, 2019.
3. **Khosla, Vaishali R., & Bhagat, Kavita.** *Human Values and Professional Ethics*. 2nd Edition. Macmillan Education, 2020.
4. **Harris, C.E., Pritchard, M.S., & Rabins, M.J.** *Engineering Ethics: Concepts and Cases*. 6th Edition. CENGAGE Learning, 2019.
5. **Murthy, PSR.** *Indian Culture, Values and Professional Ethics*. 4th Edition. BS Publications, 2022.

Reference books:

1. **Kumar, Niraj.** *Lexicon for Ethics, Integrity & Aptitude for IAS General Studies Paper IV*. 2nd Edition. McGraw Hill Education, 2023.
2. **Subba Rao, G., & Roy Chowdhury, P. N.** *Ethics, Integrity & Aptitude*. 3rd Edition. McGraw Hill Education, 2020.

Online References:

1. https://fdp-si.aicte-india.org/index.php
2. https://example.com/

Course Assessment:
Internal Assessment Method (With Rubrics)
The internal assessment will consist of **Continuous Internal Assessment (CIAP) = 50 marks** based on **Assignments, Case Studies, Presentations, and Practicum Projects**.

Assessment Component	Weightage (%)	Evaluation Criteria (Rubrics)
Assignment on Human Values	20%	- Excellent (5): Demonstrates deep understanding with real-life examples - Good (4): Good understanding with relevant examples - Satisfactory (3): Basic understanding with minimal examples - Needs Improvement (2): Partial understanding with errors - Poor (1): Little to no understanding
Case Study on Ethical Issues in IT	20%	- Excellent (5): In-depth analysis with ethical theories and solutions - Good (4): Covers major ethical aspects with examples - Satisfactory (3): Identifies ethical concerns with some analysis - Needs Improvement (2): Limited understanding with minor errors - Poor (1): Lacks analysis and ethical reasoning
Presentation on	20%	- Excellent (5): Well-structured, engaging, innovative ideas

Sustainability in IT		- Good (4): Clear and logical presentation with good insights - Satisfactory (3): Covers major points but lacks depth - Needs Improvement (2): Some points missing, lacks clarity - Poor (1): Unstructured, lacks coherence
Reflection Report on Practicum Project	20%	- Excellent (5): Thoughtful reflection, well-articulated impact - Good (4): Covers personal learning and impact clearly - Satisfactory (3): General reflection with limited depth - Needs Improvement (2): Superficial understanding - Poor (1): Minimal effort, lacks insight
Participation in Discussion & Engagement	20%	- Excellent (5): Actively participates, provides insightful contributions - Good (4): Engaged, contributes relevant thoughts - Satisfactory (3): Participates but with limited contribution - Needs Improvement (2): Rarely participates, minimal effort - Poor (1): No participation

Examples of Practicum Projects for Community Engagement and IT for Social Good

The practicum project aims to encourage students to apply **Universal Human Values (UHV)** and **Ethics in IT** to solve real-world societal challenges. Below are some project ideas along with explanations of how they integrate **human values and ethics**:

Digital Literacy Program for Underprivileged Communities

Objective: Create and conduct workshops to educate marginalized communities about basic computer skills, cybersecurity awareness, and digital payments.

Implementation:

- Design an easy-to-understand curriculum on digital literacy.
- Conduct workshops/webinars in rural schools or community centers.
- Develop a simple mobile/web application for learning digital skills.
- Educate participants about data privacy, cyber threats, and ethical internet use.

Human Values & Ethics Integration:

- **Empathy & Compassion** – Address digital divide and empower underprivileged individuals.
- **Integrity & Responsibility** – Teach ethical use of technology and responsible online behavior.
- **Public Welfare** – Ensure safe digital access for vulnerable communities.

AI-Based Cyberbullying Detection for Schools & Colleges

Objective: Develop an AI model to identify cyberbullying in chat messages and social media posts, ensuring a safer digital environment.

Implementation:

- Collect and train data on cyberbullying-related words & phrases.
- Implement a Natural Language Processing (NLP)-based chatbot to detect abusive content.
- Educate students on ethical social media behavior and reporting mechanisms.
- Partner with schools/colleges to deploy the model in their IT systems.

Human Values & Ethics Integration:

- **Respect & Non-Partisanship** – Encourage online respectful interactions.
- **Fairness & Objectivity** – Ensure non-biased AI in content moderation.
- **Safety & Privacy** – Protect users' personal data and identity.

Green Computing Awareness & E-Waste Management App

Objective: Develop an app to educate users on sustainable IT practices and provide an e-waste collection service.

Implementation:

- Create an app that guides users on green computing practices.
- Provide nearby e-waste collection centers and reward users for recycling.
- Conduct IT industry awareness campaigns on energy-efficient computing.
- Promote the use of renewable energy in data centers.

Human Values & Ethics Integration:

- **Environmental Sustainability** – Encourage eco-friendly IT solutions.
- **Social Responsibility** – Spread awareness about ethical e-waste disposal.
- **Harmony in Nature** – Minimize IT sector's negative impact on nature.

Cybersecurity Awareness Chatbot for Senior Citizens

Objective: Build a WhatsApp or Telegram chatbot that assists senior citizens in identifying and avoiding online scams, phishing, and frauds.

Implementation:

- Develop an AI chatbot that explains common online scams.
- Create step-by-step tutorials on safe internet banking and social media usage.
- Partner with local community centers and NGOs to spread awareness.
- Ensure chatbot provides real-time support and automated alerts.

Human Values & Ethics Integration:

- **Compassion & Empathy** – Assist vulnerable groups in safe internet use.
- **Integrity & Awareness** – Promote honest and secure online transactions.
- **Public Welfare** – Reduce cyber frauds targeting elderly people.

AI Ethics Awareness in IT Companies & Colleges

Objective: Develop an interactive website or mobile app to educate IT professionals and students on ethical AI usage and biases in AI systems.

Implementation:

- Provide interactive case studies on AI bias, privacy, and ethical dilemmas.
- Conduct quiz-based learning to test AI ethical understanding.
- Collaborate with IT professionals and faculty to design real-world scenarios.
- Ensure alignment with global AI ethics standards (e.g., IEEE, EU AI Act).

Human Values & Ethics Integration:

- **Integrity & Fairness** – Ensure unbiased AI algorithms.
- **Public Interest** – Educate developers on responsible AI implementation.
- **Transparency** – Promote explainable and fair AI decision-making.

Mobile App for Volunteer & Donation Matching

Objective: Develop a volunteer-matching platform that connects IT professionals and students with social organizations in need of technical assistance.

Implementation:

- Allow users to register their skills (app development, cybersecurity, etc.).
- Connect them with NGOs or community projects that require IT support.
- Enable secure crowdfunding and donation tracking for transparency.
- Promote projects focused on digital inclusion and education.

Human Values & Ethics Integration:

- **Social Responsibility** – Encourage IT professionals to give back to society.
- **Transparency & Trust** – Maintain fair donation tracking.
- **Empathy & Compassion** – Align IT skills with community development.

Ethical Hacking & Cybersecurity Training for Students

Objective: Conduct a hands-on ethical hacking workshop to educate students on ethical penetration testing and cybersecurity best practices.

Implementation:

- Develop training modules on ethical hacking, cryptography, and network security.
- Conduct capture-the-flag (CTF) cybersecurity challenges for hands-on learning.
- Educate students on responsible disclosure of vulnerabilities.
- Partner with cybersecurity firms for internships and projects.

Human Values & Ethics Integration:

- **Ethical Responsibility** – Train IT students to prevent cybercrimes.
- **Accountability** – Promote responsible ethical hacking practices.
- **Public Safety** – Improve cybersecurity awareness in college networks.

AI-Powered Sign Language Recognition System

Objective: Develop an AI-based sign language recognition system to help hearing-impaired individuals communicate using real-time gesture recognition.

Implementation:

- Train a machine learning model on Indian Sign Language (ISL).
- Develop a mobile/web app that converts sign language gestures into text/speech.
- Partner with special education institutes and NGOs for deployment.
- Ensure open-source availability for future development.

Human Values & Ethics Integration:

- **Inclusion & Accessibility** – Bridge communication gaps for disabled individuals.
- **Fairness & Transparency** – Ensure AI is unbiased across different sign languages.
- **Social Welfare** – Enhance digital accessibility for differently-abled people.

- **Project Submission & Reflection Report**

After completing the practicum project, students will submit a reflective report covering:

1. **Project Objective & Problem Statement**
2. **Implementation Details & Challenges Faced**
3. **Human Values & Ethics Integrated**
4. **Impact Assessment & Learning Outcomes**
5. **Future Improvements & Scalability**

Evaluation Rubric:

- **Excellent (5):** Clear objectives, strong ethical integration, significant social impact.
- **Good (4):** Good ethical integration, minor improvement areas.
- **Satisfactory (3):** Basic implementation lacks depth in ethical application.
- **Needs Improvement (2):** Minimal social impact, weak ethical connection.
- **Poor (1):** Unclear project execution, little relevance to human values.

SIES Graduate School of Technology
Department of Computer Engineering
Bachelor of Engineering

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
CEM401	Mini Project 1 B	--	02	--	--	01	-	01

Course Code	Course Name	Examination Scheme					
		Theory Marks			CIAP	ESEP	Total
		Course Assessment		ESE			
		ISE	MSE				
CEM401	Mini Project 1 B	--	--	--	25	25	50

Program Outcomes addressed:

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct investigation of complex problems
5. PO5: Engineering Tool Usage
6. PO6: The Engineer and The World
7. PO7: Ethics
8. PO8: Individual and Team Work
9. PO9: Communication
10. PO10: Project Management and Finance
11. PO11: Lifelong Learning

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcome: Upon completion of this course, learners will be able to

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as a member of a group or leader.
4. Deduce the proper inferences from available results through theoretical/ experimental /simulations.
5. Analyze the impact of solutions in societal and environmental context for sustainable development.
6. Apply standard norms of engineering practices.
7. Develop skills in written and oral communication.
8. Illustrate capabilities of self-learning in a group, which leads to life-long learning.
9. Explain project management principles during project work.

Guidelines for Mini Project

1. Students shall form a group of 3 to 4 students, while forming a group shall not be allowed for less than three or more than four students, as it is a group activity.
2. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3. Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4. A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5. Faculty supervisors may give input to students during mini project activity; however, focus shall be on self-learning.
6. Students in a group should understand problems effectively, propose multiple solutions and select best possible solution in consultation with guide/ supervisor.
7. Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9. With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
10. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case-by-case basis.

Guidelines for Assessment of Mini Project: Term Work

- Term work will be assessed as Continuous Internal Assessment Practical (CIAP).
- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below.
    1. Marks awarded by guide/supervisor based on logbook: 10
    2. Marks awarded by review committee 10
    3. Quality of Project report 05

The review/progress monitoring committee may consider the following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In the first semester the entire theoretical solution shall be ready, including

components/system selection and cost analysis. Two reviews will be conducted based on the presentation given by the students' group.

- First shall be for finalization of problem
- Second shall be on finalization of proposed solution of problem.

- In the second semester the expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
  - The first review is based on the readiness of building a working prototype to be conducted.
  - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

In this case in one semester students' group shall complete project in all aspects including,

- Identification of need/problem
- Proposed final solution
- Procurement of components/systems
- Building prototype and testing

Two reviews will be conducted for continuous assessment,

- First shall be for finalization of problem and proposed solution
- Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project

Mini Project shall be assessed based on the following criteria;

1. Quality of survey/ need identification.
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions.
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness.
6. Societal impact.
7. Innovativeness.
8. Cost effectiveness and Societal impact.
9. Full functioning of working model as per stated requirements.
10. Effective use of skill sets.
11. Effective use of standard engineering norms.
12. Contribution of an individual's as member or leader.
13. Clarity in written and oral communication.

- In **one year, project**, first semester evaluation may be based on the first six criteria's and the remaining may be used for second semester evaluation of performance of students in mini project.
- In the case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- The report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of

working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organization's having experience of more than five years approved by head of Institution.

- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on the following points.

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

Oral & Practical exam (ESEP)

Based on the entire syllabus of CEM401 Mini Project End Semester Examination Practical (ESEP) will be conducted.

Internal Assessment:

For 03 credit - 80 marks subject

Assessment consists of one Mid Semester Examination (MSE) of 20 marks and In Semester Examination (ISE) of 20 marks. The MSE to be conducted based on 50 %syllabus with duration of one hour.

For 02 credit - 60 marks subject

Assessment consists of one Mid Semester Examination (MSE) of 15 marks and In Semester Examination (ISE) of 15 marks. The MSE to be conducted based on 50 %syllabus with duration of one hour.

In Semester Examination (ISE)

SE 20 marks = 05 marks attendance +15 marks for Activities.

ISE 15 marks = 05 marks attendance +10 marks for Activities.

The Rubrics for activities are as follows. The activities will be decided by course in charge and approved by HoD.

Sr.No	Rubrics	Marks
1	Multiple Choice Questions(Quiz)	05Marks
2	Literature review of papers/journals	05Marks
3	Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject	05Marks
4	Extra Experiments/Virtual Lab	05 marks
5	Content beyond syllabus presentation	05 marks
6	Wins in the event/competition/hackathon pertaining to the course	10Marks
7	Case study, Presentation, group discussion, technical debate on recent trends in the said course	10Marks
8	NPTEL/ Coursera/ Udemy/ any MOOC Certificate course for 4 weeks or more	10Marks
9	Creating Proof of Concept	10Marks
10	Mini Project/	10Marks
11	GATE Based Assignment test/Tutorials etc	10Marks

*For sr.no.8, the date of certification exam should be with in the term and in case a student is unable complete the certification, the grading has to be done accordingly.