COMPUTATIONAL THINKING AND PROBLEM SOLVING TECHNIQUES
(Common to CSE, CSE (AI & ML), CSE (DS), IT, ECE, EEE, BME, CE, ME, CHE, PHE, AI & DS)

Regulation	Year-Sem	Course Code	Category	Periods/ Week			Credits	Maximum Marks		
				L	T	P	C	CIA	SEE	Total
R20A	I – I	A51HA	ES	2	1	-	3	30	70	100

Course Objectives: The course will enable the student:

1. To provide a working definition for the concept of computational thinking
2. To solve a problem using tools like flow charts, pseudo code to express the algorithms
3. To understand how lists, trees, and graphs are correlated to familiar concepts such as family trees, road maps, and organizational charts
4. To develop a base for advanced study in Problem Solving heuristic techniques and design techniques

Unit I **(8 Periods)**

Introduction to Computational thinking- Definition, objectives, how is computational thinking used? Logical and algorithmic thinking, Problem solving and Decomposing complex problem.

Introduction to Information and data: Definitions, converting information into data, Data capacity, Data types, Data Encoding and Data Compression.

Unit II **(12 Periods)**

Computational Problems: Standard problems, [GCD, Factorial of a number, Finding roots, Generating factors of a number, Checking for leap year], Permutations and Combinations, simple and compound interests, ratio and proportion, partnership problems and Number series problems (Fibonacci series, natural numbers, even numbers, prime numbers, multiplication table, palindrome numbers).

Problem solving elements-Algorithms, Definition and characteristics; Flowchart, notations and symbols (selection and repetition); Pseudo code and its representation, writing of pseudo code for various problems; Activity diagram notations with examples.

Unit III **(9 Periods)**

Data organization: Lists-arrays; Graphs-Terminology and properties, Hierarchies- organizational charts, family tree, String- basics, string operations, patterns, how to write a pattern, repetition rules.

Unit IV **(10 Periods)**

Problem Solving heuristic Techniques: Recursive and Non-recursive techniques. **Problem solving designing techniques**: Brute force, divide and conquer and greedy strategies.

Unit V **(9 Periods)**

Modeling Solutions: Top down design for the given problem statements-The process flow of an ATM machine, Hospital management system, Online shopping (E-commerce), Interpreting COVID-19 test results.

Problem Solving Cycle: Problem Definition, Logical reasoning, Decomposition, Abstraction: Class diagrams and Use Case diagrams. Designing solution for Railway reservation system and Library management system.

Course Outcomes:

1. Experiencing the importance of computational thinking.
2. Selecting basic arithmetic operations in solving mathematical problems using mental methods, paper-and-pencil and other tools.
3. Able to understand and use the main concepts for organizing information, to develop algorithms for addressing computational related tasks.
4. Formulating problems to enable computer and other tools to solve them.
5. Solving real-world complex problems using divide and conquer like strategies.

Text Books:

1. David Riley and Kenny Hunt, Computational Thinking for Modern Solver, Chapman & Hall / CRC, 2014
2. "Computational Thinking - A beginner's guide to problem-solving and programming" by Karl Beecher, Released August 2017, Publisher(s): BCS Learning & Development Limited, ISBN: 9781780173641

Reference Books:

1. R. G. Dromey, "How to solve it by Computer", PHI, 2008 Symbiosis International University, PUNE
2. www2.cs.uidaho.edu/~mdwilder/cs112/syllabus.pdf -University of Idaho, Moscow, ID 83844
3. https://www.coursera.org/learn/computational-thinking-problem-solving. - Created by University of Pennsylvania and powered by Coursera
4. https://www.sciencedirect.com/science/article/pii/S2405844019364801 - Research article "Skills in computational thinking of engineering students of the first school year"
5. T. Doleck, P. Bazelais, D.J. Lemay, et al. "Algorithmic thinking, cooperativity, creativity, critical thinking, and problem solving: exploring the relationship between computational thinking skills and academic performance"
6. J. Comput. Educ., 355 (2017), p. 4, 10.1007/s40692-017-0090-9
7. J. M. Wing, "Computational thinking," Communications of the ACM, vol. 49, no. 3, 2006. https://doi.org/10.1145/1118178.1118215.