Detailed Syllabus
Lecture-wise Breakup

Subject Code	15B11CI411	**Semester:** Even	**Semester IV Session** **Month from:** January to June **(2022)**
Subject Name	Algorithms and Problem Solving		
Credits	**3-0**	**Contact Hours**	**3**

Faculty (Names)	**Coordinator(s)**	Dr.Tribhuwan KumarTewari (J62),Dr.Pulkit Mehndiratta (J128)
	Teacher(s) (Alphabetically)	J62–Dr.Jyoti,Dr.Suma Dawn,Dr.Taj Alam,Dr.Tribhu wan KumarTewari,Dr.Vivek Kumar Singh J128 – Dr.Pulkit Mehndiratta (J128), Mrs Akanksha, Prof. Krishna Asawa, Dr. Himani, Dr. Shikha, Mr. Surender, Mrs. Varsha

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Analyze the complexity of different algorithms using asymptotic analysis.	Analyze Level (Level 4)
CO2	Select appropriate sorting and searching technique for problem solving	Apply Level (Level 3)
CO3	Apply various algorithm design principles for solving a given problem.	Apply Level (Level 3)
CO4	Identify, formulate and design an efficient solution to a given problem using appropriate data structure and algorithm design technique.	Create Level (Level 6)

Module No.	**Subtitle of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Introduction to problem solving approach; Asymptotic Analysis: Growth of Functions and Solving Recurrences; Notations- Big O, big omega, big theta, little o; Empirical analysis of sorting and searching algorithms – Merge sort, Quick sort, Heap sort, Radix sort, Count sort, Binary search, and Median search	7
2.	Design Technique: Divide and Conquer	Fundamentals of Divide and Conquer (D&C) approach using Binary search, Quick sort, and Merge sort; Strassen's matrix multiplication; and Closest pair, etc.	3
3.	Design Technique: Greedy Algorithms	Introduction to greedy based solution approach; Minimum Spanning Trees (Prim's and Kruskal algorithms); Shortest Path using Dijkstra's algorithm; Fractional and 0/1 Knapsack; Coinage problem; Bin packing; Job scheduling – Shortest job first, Shortest remaining job first, etc.; Graph coloring; and Text compression using Huffman coding and Shannon-Fanon coding, etc.	6
4.	Design Technique: Backtracking	Review of backtracking based solution approach using N queen, and Rat in a maze; M-coloring problem;	6

	Algorithms	Hamiltonian Cycle detection; Travelling salesman problem; Network flow	
5.	Dynamic Programming	Fundamentals of Dynamic programming based solution approach; 0/1 Knapsack ; Shortest path using Floyd Warshall; Coinage problem; Matrix Chain Multiplication; Longest common subsequence; Longest increasing sequence, String editing	7
6.	String Algorithms	Naïve String Matching, Finite Automata Matcher, Rabin Karp matching algorithm, Knuth Morris Pratt, Solving string problems using string data structures like Tries, Suffix Tree, and Suffix Array	6
7.	Problem Spaces and Problem solving by search	Problem Spaces: States, goals and operators, Factored representation (factoring state into variables) Uninformed search (BFS, DFS, DFS with iterative deepening), Heuristics and informed search (hill-climbing, generic best-first, A*)	5
8.	Tractable and Non-Tractable Problems	Efficiency and Tractability, P, NP, NP-Complete, NP- Hard problems	2
		Total number of Lectures	**42**

EvaluationCriteria

Components	**MaximumMarks**
T1	20
T2	20
EndSemesterExamination	35
TA	25(Attendance/Assignment/Mini-project)
Total	**100**

Project based learning: Each student in a group of 3-4 will have to develop a mini project based on data structures algorithms. The students can opt any real-world application where these algorithms can be applied. The students have to implement the mini project using C/C++/Java language. Project development and its presentation will enhance coding skills, knowledge and employability of the students in IT sector.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. **(ReferenceBooks,**Journals, Reports,Websites etc.inthe IEEE format)

1.	ThomasH.Cormen,CharlesE.Leiserson,RonaldL.Rivest,andCliffordStein ,Introductionto Algorithms,MITPress,3rdEdition,2009
2.	StevenSkiena ,The AlgorithmDesignManual,Springer;2ndedition,2008
3.	Knuth,Theart ofComputer ProgrammingVolume1,FundamentalAlgorithms,Addison-Wesley Professional;3edition,1997
4.	HorowitzandSahni,Fundamentalsof ComputerAlgorithms,ComputerSciencePress,2008
5.	Sedgewick,AlgorithmsinC,3rdedition.AddisonWesley,2002
6.	AlfredV. Aho,J.E. Hopcroft,JeffreyD.Ullman, DataStructuresand Algorithms,Addison-WesleySeries in ComputerScienceandInformationProcessing,1983

7.	ACMTransactionsonAlgorithms(TALG)
8.	AlgorithmicaJournal,Springer
9.	GraphsandCombinatorics,Journal,Springer
10.	TheACMJournalof ExperimentalAlgorithmics
RecommendedReadingmaterial: Author(s),Title,Edition,Publisher,Year ofPublicationetc.**(Text books**)	
1.	Tim Rough garden,AlgorithmsIlluminated: Part1:TheBasics,SoundlikeyourselfPublishing,September 27, 2017
2.	Tim Rough garden, Algorithms Illuminated:Part 2: Graph Algorithms and DataStructures ,SoundlikeyourselfPublishing,FirstEdition,2018.
3.	Tim Roughgarden, Algorithms Illuminated :Part3:Greedy Algorithms and Dynamic Programming,SoundlikeyourselfPublishing,First Edition,2019.
4.	Weiss,Data StructuresandAlgorithmAnalysisinC++,4thEdition**,**Pearson,2014