SCHEME OF COURSE WORK

Course Details:

Course Title	Advanced Data Structures (Professional Elective – I)		
Course Code	15CT1111	L T P C	:3 0 0 3
Program:	B.Tech.		
Specialization:	Information Technology		
Semester	IV		
Prerequisites	None		
Courses to which it is a prerequisite	None		

Course Outcomes (COs):

1	Apply concepts of Heaps.
2	Use Hash functions in indexing.
3	Design applications using Red-Black and Splay trees.
4	Explain Digital Search Structures.
5	Apply various String Matching Techniques.

Program Outcomes (POs):

A graduate of Information Technology will be able to

1	Apply the knowledge of mathematics, science, engineering fundamentals and principles of Information Technology to solve problems in different domains.
2	Analyze a problem, identify and formulate the computing requirements appropriate to its solution.
3	Design & develop software applications that meet the desired specifications within the realistic constraints to serve the needs of the society.
4	Design and conduct experiments, as well as to analyze and interpret data
5	Use appropriate techniques & tools to solve engineering problems.
6	Understand the impact of information technology on environment and the evolution and importance of green computing
7	Analyze the local and global impact of computing on individual as well as on society and incorporate the results in to engineering practice.
8	Demonstrate professional ethical practices and social responsibilities in global and societal contexts.
9	Function effectively as an individual, and as a member or leader in diverse and multidisciplinary teams.
10	Communicate effectively with the engineering community and with society at large.
11	Understand engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects.
12	Recognize the need for updating the knowledge in the chosen field and imbibing learning to learn skills.

Course Outcomes Program Outcomes Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3			3	3		3			2		3	3	2	
CO-2		3			2								3	2	
CO-3	3	3		3	3		3	2			2	3	3	2	
CO-4		2		2			3					2	3	2	
CO-5	3	3		3	3	2	2		2				3	2	

S - Strongly correlated, *M - Moderately* correlated, *Blank - No correlation*

Assessment Methods:	Seminar / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week	TOPIC / CONTENTS	Course Outcomes	Sample questions	TEACHING-LEARNING STRATEGY	Assessment Method & Schedule
1	**UNIT-I:** Single and double ended Priority Queues, Leftist Trees – Height Biased Leftist Trees, Leftist Trees – Weight – Biased Leftist Trees, Binomial Heaps – Cost Amortization, Definition of Binomial Heaps	CO1	1. What is the Difference Between single and double ended priority queues. 2. Explain in detail about Height Biased Leftist Trees. 3. Explain in detail about Weight Biased leftist Trees. 4. Define Binomial Heaps.	▫ Lecture	Mid –Test 1
2	Insertion into Binomial Heaps, Melding Two Binomial Heaps, Deletion of Minimum Element, Analysis	CO1	1. Write a procedure to insert an element into a Binomial Heap. 2. Write a procedure to meld two binomial heaps. 3. Write an algorithm to delete smallest element from heap.	▫ Lecture	Mid –Test 1
3	Fibonacci Heaps- Definition, Deletion from an F-Heap, Decrease Key, Cascading Cut, Analysis, Application to the Shortest Paths Problem, Pairing Heaps- Definition, Meld and Insert	CO1	1.Prove that if we start with empty F-Heaps and perform only the operations insert, meld, and delete min, then all min trees in the F-heaps are binomial trees.	▫ Lecture	Mid –Test 1
4	Decrease Key, Delete Min, Arbitrary Delete, Implementation Considerations, Complexity	CO1	1.Into an empty two pass min pairing heap, insert elements with priorities 20, 10, 5, 18, 6, 12, 14, 9, 8 and 22(in this order). Show the min pairing heap following each insert.	▫ Lecture /	Mid –Test 1
5	**UNIT II:** Hash Functions, Division, Folding, Mid Square Function, Extraction, Radix Transformation, Collision Resolution, Open Addressing, Chaining	CO2	1. What is the minimum number of keys that are hashed to their home positions using the linear probing technique? Show an example using a 5-cell array. 2. Is there any advantage to using binary search trees instead of linked lists in the separate chaining method?	▫ Lecture /	Mid –Test 1
6	Bucket Addressing, Deletion, Perfect Hash Functions – Cichelli's Mehtod, Perfect Hash Functions – The FHCD Algorithm, Hash Functions for extendible files – Extendible Hashing	CO2	1. In which case does Cichelli's method not guarantee to generate a minimal perfect hash function? 2. Apply the FHCD algorithm to the nine Muses with r=n/2=4 and then with r=2. What is the impact of the value of r on the execution of this algorithm?	▫ Lecture	Mid –Test 1 Seminar
7	Hash Functions for extendible files – Linear Hashing, **UNIT III:**Efficient Binary Search Trees: Optimal Binary Search Trees, AVL Trees, Red – Black Trees: Definition	CO2 & CO3	1. Strictly speaking, the hash function used in extendible hashing also dynamically changes. In what sense is this true? 2. Draw the transformations for the rotation types RR and RL. 3. Compare the worst-case height of a red-black tree with n nodes and that of an AVL tree with the same number of nodes.	▫ Lecture	Mid –Test 1 Seminar
8	Representation of Red-Black Tree, Searching a Red-Black Tree, Inserting into a Red-Black Tree, Joining Red-Black Trees	CO3	1.Develop the deletion transformations for Red-Black tree. Show that deletion from a Red – Black tree requires at most one rotation.	▫ Lecture	Mid –Test 1 Seminar
9	**Mid-Test 1**	CO1, CO2, CO3			Mid-Test 1 (Week 9)
10	Splitting a Red – Black Tree, Splay Trees, Bottom – Up Splay Trees, Top – Down Splay Trees	CO3	1.Obtain a function to perform a two-way join on red-black trees. You may	▫ Lecture / ▫ Demonstration	Mid –Test 2

			assume the existence of functions to search, insert, delete, and perform a three-way join. What is the time complexity of your two-way join function? 2. What is the maximum height of a bottom-up splay tree that is created as the result of n insertions made into an initially empty splay tree? Give an example of a sequence of inserts that results in a splay tree of the height?		
11	**UNIT –IV:** Digital Search Structures – Digital Search Trees, Digital Search Trees- Definition, Insertion, Deletion, Binary Tries and Patricia: Binary Tries, Compressed Binary Tries, Patricia	CO4	1. Write the binary trie functions for the search, insert, and delete operations. 2. Write a function to delete the element with key k from a Patricia.	▫ Lecture ▫ Problem solving	Mid –Test 2 Seminar
12	Multiway Tries, Definition, Searching a Trie, Sampling Strategies, Insertion into a Trie, Deletion from a Trie	CO4	1.Draw the tire obtained for the following data: AMIOT, AVENGER, AVRO, HEINKEL, HELLDIVER, MACCHI, MARAUDER, MUSTANG, SPITFIRE, SYKHOI sample the keys from left to right one character at a time.	▫ Lecture	Mid –Test 2 Seminar
13	Keys with different length, Height of Trie, Space required and alternative load structures, Prefix search and applications, Compressed Tries, Compressed Tries	CO4	1.Explain how a trie could be used to implement a spelling checker.	▫ Lecture /	Mid –Test 2 Seminar
14	Compressed Tries with Skip Fields, with labeled edges, Space Required by a compressed Trie,	CO4	1.Write an algorithm to insert a key value x into a trie in which the keys are sampled from left to right, one character at a time.	= Lecture /	Mid –Test 2
15	**UNIT – V:** String Matching- Exact String Matching – Straightforward algorithms, The Knuth – Morris – Pratt Algorithm, The Boyer – Moore Algorithm	CO5	1.Apply the Knuth-Morris-Pratt algorithm first with next and then with nextS to P=bacbaaa and T=bacbacabcbacbbbacabacbabcbbba.	= Lecture /	Mid –Test 2
16	Multiple Searches, Bit-Oriented Approach, Matching Sets of Words	CO5	1. Consider the serch for a pattern in a text when the pattern is non in the text. What is the smallest number of character comparisions in this case executed by i. Knuth-Morris-Pratt? ii. Boyer-Moore?	▫ Lecture	Mid-Test 2
17	Regular Expression and Matching, Suffix Tries and Trees, Suffix Arrays	CO5	1. Draw Ukkonen suffix tries for a. aaaa d. abcd g. aaba b. aabb e. baaa h. aaab c. abba f. abaa	▫ Lecture	Mid-Test 2
18	Mid-Test 2	CO3, CO4, CO5			Mid-Test 2
19/20	END EXAM				