INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTOR

Course Title	**ADVANCED DATA STRUCTURES**				
Course Code	BCSB02				
Programme	M.Tech				
Semester	I	CSE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Ms. S Swarajya Laxmi, Assistant Professor, CSE				
Course Faculty	Ms. S Swarajya Laxmi, Assistant Professor, CSE				

I. COURSE OVERVIEW:

The course covers the concepts of programming and demonstrates fundamental programming techniques, customs and terms including the library functions and the usage of the preprocessor. This course helps the students in gaining the knowledge to write C language applications, mathematical and engineering problems. This course helps to undertake future courses that assume this programming language as a background in C and Data Structures. Topics include variables, data types, functions, control structures, pointers, strings, arrays and dynamic allocation principles. This course in reached to student by power point presentations, lecture notes, and lab involve the problem solving in mathematical and engineering areas.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	-	-

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Advanced Data Structures	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✘	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

Each theory course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIE during the semester, marks are awarded by taking average of two session examinations.

Semester End Examination (SEE): The SEE shall be conducted for 70 marks of 3 hours duration. The syllabus for the theory courses shall be divided into FIVE UNITs and each UNIT carries equal weight age in terms of marks distribution. The question paper pattern shall be as defined below. Two full questions with 'either' 'or' choice will be drawn from each UNIT. Each question carries 14 marks. There could be a maximum of three sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
30 %	To test the analytical skill of the concept.
20 %	To test the application skill of the concept.

Continuous Internal Assessment (CIA):

For each theory course the CIA shall be conducted by the faculty/teacher handling the course as given in Table 4. CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Technical Seminar and Term Paper.

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Technical Seminar and Term Paper	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 9th and 17th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration, consisting of 5 one-mark compulsory questions in part-A and 4 questions in part-B. The student has to answer any 4 questions out of five questions, each carrying 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Technical Seminar and Term Paper:

Two seminar presentations are conducted during I year I semester and II semester. For seminar, a student under the supervision of a concerned faculty member, shall identify a topic in each course and prepare the term paper with overview of topic. The evaluation of Technical seminar and term paper is for maximum of 5 marks. Marks are awarded by taking average of marks scored in two Seminar Evaluations.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	Apply Analyze a problem, identify and define computing requirements, design and implement appropriate solutions.	3	Assignments
PO 2	Solve complex heterogeneous data intensive analytical based problems of real time scenario using state of the art hardware/software tools.	3	Assignments
PO 3	Demonstrate a degree of mastery in emerging areas of CSE/IT like IoT, AI, Data Analytics, Machine Learning, cyber security, etc.	1	Mini Project
PO 4	Write and present a substantial technical report/document.	1	Open ended experiments
PO 5	Independently carry out research/investigation and development work to solve practical problems.	1	Mini Project
PO 6	Function effectively on teams to establish goals, plan tasks, meet deadlines, manage risk and produce deliverables.	1	Seminars / Term Paper / 5 minutes video
PO 7	Engage in life-long learning and professional development through self-study, continuing education, professional and doctoral level studies.	1	----

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Understand the data structures and techniques of algorithm analysis.
II	Solve problems using different data structures and compare their performance and tradeoffs.
III	Illustrate the implementation of linked data structures such as linked lists and binary trees.
IV	Understand graph algorithms such as shortest path and minimum spanning tree.
V	Learn advanced data structures such as balanced search trees, hash tables, priority queues

VIII. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Implementation of hash tables, including collision avoidance and resolution schemes.	CLO 1	Analyze time and space complexity of an algorithm for their performance analysis.
		CLO 2	Understand arrays, single and doubly linked lists in linear data structure and tress, graphs in non-linear data structure.
		CLO 3	Master a variety of advanced abstract data type (ADT) and their implementations.

COs	Course Outcome	CLOs	Course Learning Outcome
		CLO 4	Understand dynamic data structures and relevant standard algorithms.
CO 2	Analyze how to balance a binary search tree using rotation methods and color changing methods.	CLO 5	Design and analyze and Concepts of heap, priority queue.
		CLO 6	Analyze probing methods like linear probing and quadratic probing.
		CLO 7	Understand and implement hash table and linear list representation.
		CLO 8	Understand the properties of binary tress and implement recursive and non-recursive traversals.
CO 3	Solve problems using graph algorithms, including single-source and all-pairs shortest paths, and minimum spanning tree algorithms.	CLO 9	Understand graphs terminology, representations and traversals in Graphs.
		CLO 10	Implement Depth First Search and Breath First Searching methods of non –linear data structures.
		CLO 11	Analyze dijkstra's algorithm for single source shortest path problem for minimum cost spanning trees.
		CLO 12	Implement binary search ADT for finding parent node, smallest and largest values in binary search.
CO 4	Relates all binary heap trees to form a large binomial queue for large data structures creation.	CLO 13	Understand and implement operations and applications of red-Black and splay Trees
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		CLO 13	Understand and implement operations and applications of red-Black and splay Trees
		CLO 13	Understand and implement operations and applications of red-Black and splay Trees
CO 5	Reconstructs such applications that take the advantage of a trie's ability to quickly search for, insert, and delete entries into the dictionary.	CLO 13	Understand and implement operations and applications of red-Black and splay Trees
		CLO 14	Implement Huffman Coding and decoding for text compression
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		CLO 14	Implement Huffman Coding and decoding for text compression

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCSB02.01	CLO 1	Analyze time and space complexity of an algorithm for their performance analysis.	PO 1, PO 2, PO 3	2
BCSB02.02	CLO 2	Understand arrays, single and doubly linked lists in linear data structure and tress, graphs in non-linear data structure.	PO 1, PO 2, PO 3, PO 4	2
BCSB02.03	CLO 3	Master a variety of advanced abstract data type (ADT) and their implementations.	PO 1, PO 2	2
BCSB02.04	CLO 4	Understand dynamic data structures and relevant standard algorithms.	PO 1, PO 2, PO 3	1
BCSB02.05	CLO 5	Design and analyze and Concepts of heap, priority queue.	PO 1, PO 2, PO 3	2
BCSB02.06	CLO 6	Analyze probing methods like linear probing and quadratic probing.	PO 1, PO 2, PO 4	2
BCSB02.07	CLO 7	Understand and implement hash table and linear list representation.	PO 1, PO 2, PO 4	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCSB02.08	CLO 8	Understand the properties of binary tress and implement recursive and non-recursive traversals.	PO 1, PO 2, PO 3	1
BCSB02.09	CLO 9	Understand graphs terminology, representations and traversals in Graphs.	PO 1, PO 2, PO 3	1
BCSB02.10	CLO 10	Implement Depth First Search and Breath First Searching methods of non –linear data structures.	PO 1, PO 2	1
BCSB02.11	CLO 11	Analyze dijkstra's algorithm for single source shortest path problem for minimum cost spanning trees.	PO 3, PO 4	2
BCSB02.12	CLO 12	Implement binary search ADT for finding parent node, smallest and largest values in binary search.	PO 1, PO 2	2
BCSB02.13	CLO 13	Understand and implement operations and applications of red-Black and splay Trees	PO 1, PO 2, PO 4	2
BCSB02.14	CLO 14	Implement Huffman Coding and decoding for text compression	PO 3, PO 4	2

3= High; 2 = Medium; 1 = Low

X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (POs)						
	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7
CO 1	3	2	2	2		1	
CO 2	2	2	1	1			
CO 3	1	2	2	1	1		
CO 4	2		2	2		1	
CO 5			2	1			1

XI. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO 1	2	2	2		1		
CLO 2	2	2	2	2	1		
CLO 3	2	2				1	
CLO 4	1	1	1				1
CLO 5	2	2	2				1
CLO 6		1	1	1			1
CLO 7	1	1	1				
CLO 8	2	2		2			
CLO 9	1	1	1				

Course Learning Outcomes (CLOs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO 10	2	2					
CLO 11	2		2	2			
CLO 12	2		2	2			
CLO 13	2	2					
CLO 14	2	2		2			

3 = High; 2 = Medium; 1 = Low

XII. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1,PO2, PO 3, PO 4	SEE Exams	PO1, PO2, PO 4	Assignments	PO 1	Seminars	PO 1, PSO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XIII. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIV. SYLLABUS

UNIT- I	OVERVIEW OF DATA STRUCTURES
Algorithm analysis: Algorithms; Performance analysis: Time complexity and space complexity, asymptotic notation: Big Oh, omega and theta notations, complexity analysis examples; Data structures: Linear and non linear data structures, ADT concept, linear list ADT, stack and queue ADTs, array and linked list representations; Circular queue: Insertion and deletion, de queue ADT, priority queue ADT, implementation using heaps, insertion into a max heap, deletion from a max heap, singly linked lists, doubly linked lists, circular linked list.	
UNIT - II	**DICTIONARIES, HASH TABLES**
Dictionaries: Linear list representation, operations insertion, deletion and searching, hash table representation, hash functions, collision resolution, separate chaining, open addressing, linear probing, quadratic probing, double hashing, rehashing, extendible hashing	
UNIT - III	**TREES AND GRAPHS**
Trees: Ordinary and binary trees terminology, properties of binary trees, binary tree ADT, representations, recursive and non recursive traversals, threaded binary trees. Graphs: Graphs terminology, graph ADT, representations, graph traversals; Search methods: DFS and BFS; Applications of Graphs: Minimum cost spanning tree using Kruskal‟s algorithm, Dijkstra‟s algorithm for single source shortest path problem.	

UNIT - IV	SEARCH TREES I
Binary search tree: Binary search tree ADT, insertion, deletion and searching operations, finding the parent of a given node, attaining a reference to a node, finding the smallest and largest values in the binary search tree. Balanced search trees: AVL trees, definition, height of an AVL tree; Operations : Insertion, deletion and searching.	
UNIT - V	**SEARCH TREES II**
Red-Black and Splay Trees; B trees: Definition, operations and applications; R trees: Nearest neighbor query, join and range queries; Comparison of search trees; Text compression: Huffman coding and decoding; Pattern matching: KMP algorithm.	

Text Books:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press Private Limited, India, 2nd Edition, 2008.
2. G.A. V.Pai, "Data Structures and Algorithms", Tata McGraw Hill, New Delhi, 1st Edition, 2008.
3. M. A. Weiss, Addison Wesley, "Data Structures and Algorithm Analysis in Java", Pearson Education, 2nd Edition, 2005.

Reference Books:

1. D. Samanta, "Classic Data Structures", Prentice Hall of India Private Limited, 2nd Edition, 2003.
2. Aho, Hop craft, Ullman, "Design and Analysis of Computer Algorithms", Pearson Education India, 1stEdition, 1998.
3. Goodman, Hedetniemi, "Introduction tothe Design and Analysis of Algorithms", Tata McGraw Hill, New Delhi, India, 1st Edition, 2002.
4. Adam Drozdek, "Data Structures and Algorithms in C++", Thomson Course Technology, 3rd Edition, 2005.
5. M. T. Goodrich, R. Tomassia, "Data structures and Algorithms in Java", Wiley India, 3rd Edition, 2011.

XV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Analyze time and space complexity of an algorithm for their performance analysis	CLO 1	T1: 1.1-1.5
2	Analyze time and space complexity of an algorithm for their performance analysis	CLO 2	T1: 2.1-2.8
3	Understand arrays, single and doubly linked lists in linear data structure and tress , graphs in non-linear data structure	CLO 3	T1: 3.1-3.6
4-6	Master a variety of advanced abstract data type (ADT) and their implementations	CLO 4	T1: 5.1-5.3
7-11	Understand dynamic data structures and relevant standard algorithms	CLO 5	T1: 5.4-5.7
12-16	Understand dynamic data structures and relevant standard algorithms	CLO 6	T2:5.1-5.5
17-22	Understand the properties of binary tress and implement recursive and non- recursive traversals	CLO 7	T2:10.2.3
23-28	Understand the properties of binary tress and implement recursive and non- recursive traversals	CLO 8	T1:8.1-8.4
29-32	Understand graphs terminology, representations and traversals in Graphs	CLO 9	T2:9.1-9.6
33-39	Understand graphs terminology, representations and traversals in Graphs	CLO 10	T1:11.1-11.4
40-41	Understand the properties of binary tress and implement recursive and non- recursive traversals	CLO 11	T1:20.1-20.7

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
42-43	Understand the properties of binary tress and implement recursive and non- recursive traversals	CLO 12	T1:20.8-20.9
44	Understand and implement operations and applications of red-Black and splay Trees	CLO 13	T3:25.1-20.3
45	Implement Huffman Coding and decoding for text compression	CLO 14	T3:28.1-28.7

XVI. GAPS IN THE SYLLABUS-TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Sorting Algorithms	Seminars / Guest Lectures / NPTEL	PO 1, PO 2, PO 3	PEO1, PEO 2
2	Binary Tree Traversals	Seminars / Guest Lectures / NPTEL	PO 2, PO 3	PEO 1
3	Hash Function	Assignments / Laboratory Practices	PO 1, PO 3, PO 4	PEO 2

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