Hall Ticket No | | | | | | | | | | Question Paper Code: AIT001

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER - I

Second Year B.Tech III Semester End Examinations, November – 2018

Regulations: R16

DESIGN AND ANALYSIS OF ALGORITHMS

(Common to CSE / IT)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. a) Discuss various the asymptotic notations used for best case average case and worst case analysis of algorithms. **[7M]**
   b) Sort the list of numbers using merge sort: 78, 32, 42, 62, 98, 12, 34, and 83. **[7M]**
2. a) Discuss recursive and iterative versions of binary search algorithm and compare their time complexities. **[7M]**
   b) Describe Strassen's matrix multiplication with example and derive its time complexity. **[7M]**

UNIT – II

3. a) Illustrate the inorder, preorder, postorder traversal of the following Binary tree Fig:1. **[7M]**

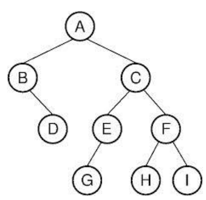

Fig:1

   b) Show that for any undirected graph G = (V, E), call to BFS(v) with v ϵ V results in visiting all the vertices in the connected component containing v. **[7M]**

4. a) Illustrate BFS and DFS traversal of following graphFig:2. **[7M]**

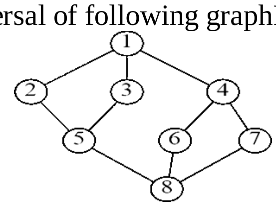

Fig:2

b) Experimentally compare the performance of Simple Union and Simple Find with Weighted Union and Collapsing Find. For this generate a random sequence of union and find operations. **[7M]**

UNIT – III

5. a) Explain the steps in finding minimum cost spanning tree of graph using Prim's algorithm and also derive its time complexity. **[7M]**

   b) Construct optimal binary search for (a1, a2, a3, a4) = (do, if, int, while), p(1 : 4) = (3,3,1,1) q(0 : 4)= (2,3,1,1,1). **[7M]**

6. a) Compute the optimal solution for knapsack problem using greedy method N=3, M= 20, (p1,p2,p3)= (25,24,15), (w1,w2,w3) =(18,15,10). **[7M]**

   b) Explain the method involved in finding shortest path for each pair of vertices (i, j), where i, j ϵ V. **[7M]**

UNIT – IV

7. a) Explain subset-sum problem and discuss the possible solution strategies using backtracking. **[7M]**

   b) Draw the portion of state space tree generated by LCBB by the following knapsack problem n=5, (p1,p2,p3,p4,p5) =(10,15,6, 8, 4), (w1,w2,w3,w4,w5)=(4,6,3,4,2) and m=12. **[7M]**

8. a) Write an algorithm for N-queens problem using backtracking. **[7M]**

   b) Solve the instance of travelling sales person problem given Fig:3 using Least Cost Branch Bound. **[7M]**

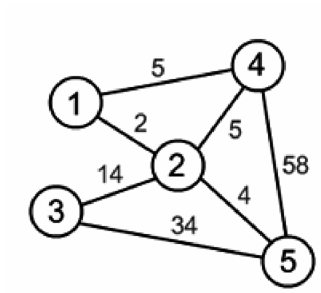

Fig:3

UNIT – V

9. a) **Given** two sets S1 and S2, the disjoint sets problem is to check whether the sets haveacommon element. Present an O(1) time non deterministic algorithm for this problem. **[7M]**

   b) **Explain** clique decision problem and chromatic number decision problems with examples. **[7M]**

10. a) **Explain** P, NP, NP-complete, NP-hard problems and show their relationship. **[7M]**

    b) **Differentiate** deterministic and non-deterministic algorithms. **[7M]**

DESIGN AND ANALYSIS OF ALGORITHMS

III Semester: **CSE/IT**

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AIT001	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Assess how the choice of data structures and algorithm design methods impacts the performance of programs.
II. Solve problems using data structures such as binary search trees, and graphs and writing programs for these solutions.
III. Choose the appropriate data structure and algorithm design method for a specified application.
IV. Solve problems using algorithm design methods such as the greedy method, divide and conquer, dynamic programming, backtracking, and branch and bound and writing programs for these solutions.

UNIT-I **INTRODUCTION** **Classes: 9**

Algorithm: Pseudo code for expressing algorithms; Performance analysis: Space complexity, time complexity; Asymptotic notations: Big O notation, omega notation, theta notation and little o notation, probabilistic analysis, amortized complexity; Divide and Conquer: General method, binary search, quick sort, merge sort, Strassen's matrix multiplication.

UNIT-II **SEARCHING AND TRAVERSAL TECHNIQUES** **Classes: 8**

Disjoint set operations, union and find algorithms;Efficient non recursive binary tree traversal algorithms, spanning trees; Graph traversals: Breadth first search, depth first search, connected components, biconnected components.

UNIT-III **GREEDY METHOD AND DYNAMIC PROGRAMMING** **Classes: 10**

Greedy method: The general method, job sequencing with deadlines, knapsack problem, minimum cost spanning trees, single source shortest paths.

Dynamic programming: The general method, matrix chain multiplication optimal binary search trees, 0/1 knapsack problem, single source shortest paths, all pairs shortest paths problem, the travelling salesperson problem.

UNIT-IV **BACKTRACKING AND BRANCH AND BOUND** **Classes: 9**

Backtracking: The general method, the 8 queens problem, sum of subsets problem, graph coloring, Hamiltonian cycles; Branch and bound: The general method,0/1 knapsack problem, least cost branch and bound solution, first in first out branch and bound solution,travelling salesperson problem.

UNIT-V **NP-HARD AND NP-COMPLETE PROBLEMS** **Classes: 9**

Basic concepts: Non-deterministic algorithms, the classes NP - Hard and NP, NP Hard problems, clique decision problem,chromatic number decision problem, Cook's theorem.

Text Books:

1. EllisHorowitz, SatrajSahni, Sanguthevar Rajasekharan, “Fundamentals of Computer Algorithms”, UniversitiesPress, 2nd Edition, 2008.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D, “The Design And Analysis Of Computer Algorithms”, Pearson India, 1stEdition, 2013.

Reference Books:

1. Levitin A, “Introduction to the Design and Analysis of Algorithms”, Pearson Education, 3rd Edition, 2012.
2. Goodrich, M. T. R Tamassia, “Algorithm Design Foundations Analysis and Internet Examples”, John Wileyn and Sons, 1st Edition, 2001.
3. Base Sara Allen Vangelder, “Computer Algorithms Introduction to Design and Analysis”, Pearson, 3rd Edition, 1999.

COURSE OUTCOMES (CO’s):

1. **Analyze** the running time and space complexity of algorithms.
2. **Use** the mathematical techniques required to prove the time complexity of a program/algorithm and understand tree traversals, Graph traversals and spanning trees.
3. **Illustrate** disjoint set operations union and find.
4. **Demonstrate** non recursive tree traversal algorithms.
5. **Describe** the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it.
6. **Derive** and solve recurrences describing the performance of divide-and-conquer algorithms.
7. **Illustrate** the greedy paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize greedy algorithms, and analyze them.
8. **Synthesize** new graph algorithms and algorithms that employ graph computations as key components, and analyze them.
9. **Explain** the dynamic-programming paradigm and recite algorithms that employ this paradigm. Synthesize dynamic-programming algorithms, and analyze them.
10. **Apply** Backtracking to n-queen problem, sum of subsets problem, graph coloring and branch and bound to Travelling sales person problem, 0/1 knapsack problem etc.
11. **Describe** the notions of P, NP, NP-complete, and NP-hard.
12. **Able** to apply and implement learned algorithm design techniques and data structures to solve problems.

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DEPARTMENT OF INFORMATION TECHNOLOGY

PROGRAM OUTCOMES	
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems anddesign system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and researchmethods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutionsin societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms ofthe engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineeringcommunity and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive
PO11	**Project management and finance**: Demonstrate knowledge and understanding of theengineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES	
PSO1	**Professional Skills:** The ability to research, understand andimplement computer programs in the areas related to algorithms, systemsoftware, multimedia, web design, big data analytics, and networking forefficient analysis and design of computer-based systems of varyingcomplexity.
PSO2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship:** The ability toemploy modern computer languages, environments, and platforms increating innovative career paths, to be an entrepreneur, and a zest forhigher studies.

MAPPING OF COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	X				X					X			X	X	
2		X	X		X				X	X			X		X
3	X	X	X		X				X	X			X		
4		X	X		X				X	X					X
5		X	X		X				X	X					X
6		X	X		X				X	X					X
7		X			X					X		X	X	X	
8		X			X				X					X	
9			X		X								X		
10		X			X					X			X	X	
11	X			X				X	X			X		X	
12		X	X			X			X		X		X		X

MAPPING OF MODEL QUESTION PAPER QUESTIONS TO THE ACHIEVEMENT OF COURSE OUTCOMES

Question Number	Course Outcomes											
	CO1	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**	**CO7**	**CO8**	**CO9**	**CO10**	**CO11**	**CO12**
1(a)	X											
1(b)		X										
2(a)		X		X								
2(b)	X					X						
3(a)				X	X							
3(b)								X				
4(a)												
4(b)			X							X		
5(a)											X	
5(b)												
6(a)									X			
6(b)												X
7(a)							X					
7(b)						X						
8(a)									X		X	
8(b)												X
9(a)									X		X	
9(b)										X		X
10(a)											X	X
10(b)											X	X

Signature of Course Coordinator **HOD, CSE**