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(Following Paper ID and Roll No. to be filled in your Answer Book)

Paper ID : 214302 Roll No. ☐☐☐☐☐☐☐☐☐☐

MCA

(SEM. III) THEORY EXAMINATION, 2015-16

DESIGN & ANALYSIS OF ALGORITHMS

[Time:3 hours] [Total Marks:100]

Note : Attempt questions from all sections as per directions.

Section-A

1. Attempt **all parts** of this section.Answer in brief :

(2x10=20)

(a) What is the smallest value of n such that an alogorithm whose running time is $50n^2$ runs faster than an algorithm whose running time is 3^n on the same machine ?

(b) Draw BSTs of height 2, 3 and 4 on the set of keys {10, 4, 5, 16, 1, 17, 21}

(c) Write down the Chinese Remainder Theorem.

(d) Name any three problems that cannot be solved by polynomial time algorithm.

(e) Give two differences between Dynamic Programming and Divide and Conquer techniques.

(f) Draw a graph with 10 vertices that has unique ordering of vertices when topologically sorted.

(g) Define Fast Fourier Transformation (FFT)

(h) What are Polynomial-time solvable and Polynomial-time variflable algorithms ?

(i) The second best minimum spanning tree of a graph can contain the smallest edge of the graph. Is this statement correct ? Justify your answer with an example.

(j) Draw all legal B-trees of minimum degree 2 that represent {10, 12, 13, 14, 15}

Section-B

Attempt **any five** questions from this section : (10 x 5 = 50)

2. Write down selection sort algorithm. Apply selection sort to sort the list {7, 3, 11, 2, 5, 12, 23, 6, 45, 4, 78, 1, 13} in ascending order.

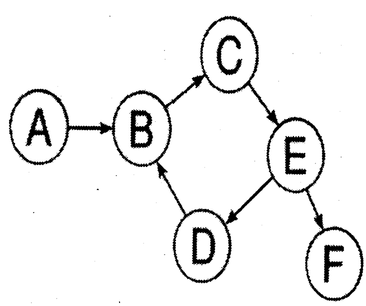
3. Solve the recurrence $T(n) = 2T(n/2) + n^2$ by using recurrence tree method.

4. Let X be a non-full internal node of a B-Tree. Let be an index such that $Y = C_i[X]$ is a full child of X. Write a procedure that splits Y such that X has an additional child now.

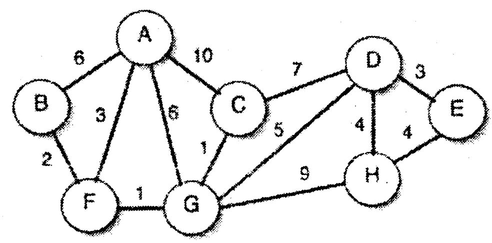
5. Define Fibonacci Heap. Discuss the structure of a Fibonacci Heap with the help of a diagram. Write a function for uniting two Fibonacci Heaps.

6. Design a recursive solution to the Longest Common Subsequence (LCS) problem. Determine an LCS of (22112121) and (211221121).

7. What are the different ways of representing a graph in the memory of a computer ? Represent the following graph using those methods.



8. (a) Write down Kruskal's algorithm that determine the minimum spanning tree of a graph. Run your algorithm on the following graph. What is the difference between Prim's and Kruskal's algorithmms during executions?



(b) Give an efficient algorithm to compute the Second-Best Minimum Spanning Tree of a graph.

9. (a) Design a Bitonic Sorter [n] where n = 8. Show that a Bitonic Sorter[n] where n is an exact power of 2 contains O (n log n) comparators.

(b) Write down Knuth Morris Pratt algorithm fopr string matching. Find the prefix function of the string **ababababca**.

Section-C

Note : Attempt **any two** questions from this section.

(15x2=30)

10. (a) Use Strassen's algorithm to compute the product of the following matrices :

$$\begin{bmatrix} 2 & 9 \\ 5 & 6 \end{bmatrix} \begin{bmatrix} 4 & 11 \\ 8 & 7 \end{bmatrix}$$

Show your work. How would .you modify Strassen's algorithm to multiply two n x n matrices in which n is not an exact power of 2.

(b) What are greedy algorithms ? Find a solution to the following activity selection problem using Greedy Technique. (The starting and finishing times of 11 activities are given as follows :

(2, 13), (8, 12), (12, 14), (3, 5), (0, 6), (1, 4), (6, 10), (5, 7), (3, 8), (5, 9), (8, 11)

11. (a) What is Branch Bound Technique ? Find a solution to the 4-Queens problem using branch and bound strategy. Draw the solution space using necessary bounding function.

(b) What is amortized analysis ? Calculate the amortized cost of (1) stack operations and (2) mincrementing a binary counter using (a) Aggregate method (b) Accounting method and (c) Potential method.

12. (a) What are approximation algorithms ? Design an algorithm that computes a near optimal tour to the travelling salesman problem with triangle inequality. Show the operation of your algorithm with an example.

(b) Prove that the satisfiability of Boolean formulae is NP complete.

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