ST. XAVIER'S COLLEGE
KOLKATA
(AUTONOMOUS)

1st SEMESTER EXAMINATION
JANUARY – FEBRUARY 2021
M.Sc. COMPUTER SCIENCE

CMSM4121

DATA STRUCTURE AND ANALYSIS OF ALGORITHMS

Wednesday, January 13, 2021
12:00 PM to 3:00 PM
3 hours
Full Marks : **80**

PLEASE READ THESE INSTRUCTIONS BEFORE YOU START WRITING:

1. Of the questions attempted, the answers to only the first required number of questions (as stipulated in the question paper) will be evaluated. **So please do not attempt extra questions**.
2. Use fountain pen or ball-point pen of **blue** or **black ink**.
3. Write **(not type)** the answers legibly, in your own words as far as practicable, on A4 size sheets.
4. Save the pages of your answer sheets (hand-written document) to a single PDF file and name the document accurately i.e. **Roll No_Paper Code.PDF** (example: 147_PH36141T).
5. Send the PDF file to the following email address **within 30 minutes of the completion of the examination**: **CMSM4121@SXCCAL.EDU**
6. In the subject field of your email, please write "**Answer Script – Roll No, Paper Code**" (example: "Answer Script – 147, PH36141T").
7. The scanned answer scripts should have **enough clarity** to enable evaluation.
8. On top of each page **handwrite** the following information: **Name, Roll Number, Paper Code , Date,** and **Page Number**
9. No multiple submissions would be allowed.

The marks are given in **brackets ( )** at the end of each question or part question.

The question paper consists of **3** pages.

Of the questions attempted, the answers to only the first required number of questions (as stipulated in the question paper) will be evaluated.
So, PLEASE DO NOT ATTEMPT EXTRA QUESTIONS.

GROUP A

Answer QUESTION 1 and ANY THREE OF THE REST

1. Critically comment on **ANY TWO** the following statements **(5×2=10)**
   (i) Quick sort is not always "quick" for all input instances.
   (ii) Dynamic programming algorithms avoid all duplicate sub instances of a problem that are otherwise generated by divide and conquer algorithms.
   (iii) $2^n+n^2+5n=\text{Omega}(n^2)$.

2. Consider the six characters A,B,C,D,E,F and their respective weights:

A	B	C	D	E	F
0.15	0.10	0.15	0.10	0.40	0.10

   Encode them using Huffman's encoding algorithm. Show that the codes obtained are immediately decodable. **(10+5)**

3. Consider the following instance of knapsack problem:
   n=3, W=20, (v1,v2,v3)= (25,24,15) and (w1,w2,w3)=(18,15,10).
   Compute at least three feasible solutions to this problem clearly indicating your strategy. Hence indicate the optimal strategy. **(12+3)**

4. Suppose you are given the problem to schedule n jobs in a single machine so as to minimize the average time a job spends on the system. What will be the optimal schedule for this problem? Write down a suitable algorithm so that you are in a position to execute this schedule. What is the worst case computing time of your algorithm? **(3+9+3)**

5. Explain clearly the objective of a Travelling Salesperson Problem (TSP). Solve it using greedy approach. Show using a suitable example that this approach may not always give a optimal solution. Hence write down a suitable algorithm to solve the TSP. **(3+5+3+4)**

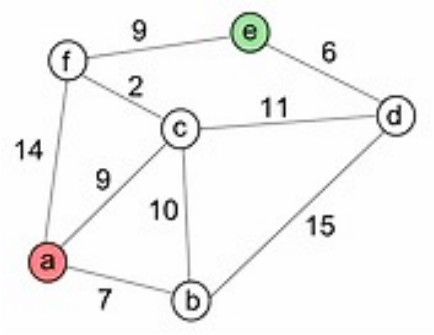
GROUP B

Answer QUESTION 6 and ANY ONE OF THE REST

6 Answer **ANY TWO** **(5×2=10)**
   (a) Define strongly connected and weakly connected graph with example. What is bipartite graph? **(4+1)**
   (b) Differentiate between graph traversal and tree traversal algorithm. **(5)**
   (c) Differentiate between articulation point and bridge in context with graph with example. What is pendant vertex? **(4+1)**

7 (a) Define AVL tree. Explain the various rotations performed on AVL Tree with examples.
   Draw the AVL Tree by inserting the following keys in the given sequence: C, A, B, D, G, E, P, R, X, T, Z **(5+5)**
   (b) Insert the following keys into a B tree of order 3 in the following sequence: 20, 80, 55, 15, 116, 39, 76, 124, 103, 48, 200, 98, 175, 235.
   What is the structure of the node if it is a 5-way B tree? **(4+1)**

8. Consider the following graph:



(a) Apply BFS from the starting vertex e coloured green. Apply DFS from the starting vertex a coloured red. **(5)**

(b) State Kruskal's algorithm for finding out the minimum spanning tree and apply this algorithm to find out the minimum spanning tree on the above graph. What is the root of this tree? **(8+2)**

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