**Computer Science and Information Management**

**School of Engineering and Technology**

**AT70.02 Data Structures and Algorithm**

**August 2022 Semester**

**FINAL EXAM**

**Instructor: CHAKLAM SILPASUWANCHAI**
**Time: 2 hours**

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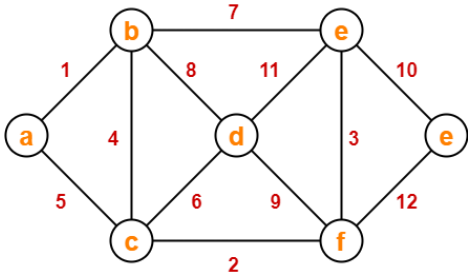
**STUDENT NAME: _____ STUDENT ID. NO. _____**

- This exam accounts for **40%** of the overall course assessment**.**
- This exam is **open-booked; open-internet.**
- **Don't write only the answer. "Precise" proof (and steps) is required for ALL questions.**
- The completed exams shall be submitted at the Google Classroom
- Good luck!

**EXAMINATION RULES:**

- For **offline students**, you may leave the room temporarily with the approval and supervision of the proctors. No extra time will be added to the exam in such cases.
    - You can submit as paper if you want
    - You can also submit via Google classroom
- For **online students**, you are required to turn on your webcam during the entire period of the exam time
- Students will be allowed to leave at the **earliest 45 minutes** after the exam has started
- All work should belong to you. A student should NOT engage in the following activities which proctors reserve the right to interpret any of such act as a**cademic dishonesty without questioning**:
    - Chatting with any human beings physically or via online methods
    - Plagiarism of any sort, i.e., copying from internet sources or friend
- No make-up exams are allowed. Special considerations may be given upon a valid reason on unpredictable events such as accidents or serious sickness.

For problems below *(1 pt. each)*, use the following graph (assume undirected graph for MST problem):




1. Perform a DFS and BFS, and write out the resulting array

2. Find an MST using Prim algorithm (reminder: assume undirected graph)

3. Find the shortest path with s = a using Bellman-Ford and Dijkstra algorithm

4. Find all-pair shortest path using Floyd-Warshall algorithm

5. Create a red-black tree by inserting $A = <1, 8, 3, 5, 7, 1, -2, 4, 0>$. (*1 pt.)*

6. Solve this 0/1 Knapsack problem with m = 11 using Dynamic Programming (*2 pts.)*

| No. | V | W | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 1 | | | | | | | | | | | |
| 2 | 1 | 3 | | | | | | | | | | | |
| 3 | 6 | 4 | | | | | | | | | | | |
| 4 | 2 | 5 | | | | | | | | | | | |
| 5 | 9 | 7 | | | | | | | | | | | |

What is the maximum value? _____
What are the items? _____

7. Solve this Coin Changing Problem using Dynamic Programming (*4 pts.)*
Table showing number of ways:

| C\N | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |

Total number of coin combinations to reach N: _____
Table showing the number of coins: _____

| C\N | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |

Minimum number of coins to reach N: _____
What are those coins: _____

8. Solve this Huffman coding problem (*1 pt.)*

| Char | Freq. |
|---|---|
| a | 62 |
| b | 7 |
| c | 33 |
| d | 5 |
| e | 14 |

Original cost without Huffman = _____
Cost with Huffman (cost of transmitting message + table) = _____

Scratch paper

GOOD LUCK! ☺