



THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF MATHEMATICS & COMPUTER SCIENCE

FIRST SEMESTER EXAMINATIONS - 2023

THIRD YEAR BACHELOR OF SCIENCE IN COMPUTER SCIENCE

CS314 – Data Structures & Algorithms

TIME ALLOWED: 3 HOURS

INFORMATION FOR CANDIDATES

1. Write your name and student number clearly on the front of the examination booklet.
2. You have 10 minutes to read this paper. You must not begin writing during this time.
3. **Section A has 10 questions.** You should **answer all** the questions.
4. **Section B has 8 questions.** You should **answer any 7** of them **ONLY**.
5. Do **not** use red ink.
6. All answers must be written in examination booklets only. No other written material will be accepted.
7. Notes and textbooks are not allowed in the examination room.
8. All mobile phones and electronic/recording devices must be switched off during the examination.

MARKING SCHEME

Marks are indicated at the beginning of each question. The total is 100 marks.

Questions	Marks
Section A (10 questions)	$10 * 3 = 30$
Section B (Any 7 questions out of 8 given)	$7 * 10 = 70$
Total marks	100

Section A has 10 questions. You should answer all the questions.

Section A (10 * 3 = 30 marks)

Question 1: (1.5 + 1.5 = 3 marks)

What is meant by data structures? How do you define algorithm as?

Question 2: (2 + 1 = 3 marks)

What is Abstract Data Type (ADT)? Give an example of ADT.

Question 3: (3 marks)

How does the stack application work during method calls?

Question 4: (3 marks)

Convert the given $A * (B + C) * D$ infix expression to postfix expression.

Question 5: (3 marks)

Draw the expression tree for the given expression $(a + b * c) + (((d * e) + f) * g)$.

Question 6: (3 marks)

Write about the role of operating system scheduler in priority queues.

Question 7: (3 marks)

How does a shell sort algorithm work or the logic behind shell sort algorithm?

Question 8: (3 marks)

Define what a graph is.

Question 9: (3 marks)

What is a minimal spanning tree in a graph?

Question 10: (3 marks)

What is meant by non-pre-emptive scheduling?

Section B – Answer any 7 only out of 8 given questions.

Section B (7 * 10 = 70 marks)

Question 11: (7 + 3 = 10 marks)

- a) Explain about the Naïve Iterative approach to calculate the n^{th} power of a number with the Algorithmic solution in steps.
- b) What are the three pitfalls of recursion?

Question 12: (5 + 2 + 3 = 10 marks)

- a) Explain how to reduce the running time of a program by mentioning at least 5 ways.
- b) Explain the Stack Abstract Data Type.
- c) Mention any 3 applications of Stack ADT.

Question 13: (5 + 5 = 10 marks)

- a) Write about the 5 applications where queues are applied according to data structures.
- b) Write the algorithm which performs the INSERT operation in **queue**.

Question 14: (5 + 5 = 10 marks)

To resolve the collision problem in hashing with linked lists; probing hash table technique was introduced. With the given key elements {89, 18, 49, 58, 69} to insert;

- a) Using the key elements depict with your **table** accordingly.
- b) Explain the **quadratic method** with the table you have worked above, to resolve problem of linear probing.

Question 15: (4 + 6 = 10 marks)

Priority queues are implemented in various applications.

- a) Write at least 4 different applications where they are used.
- b) With a neat diagram in pencil draw the binomial queue structure and explain.

Question 16: (5 + 4 + 1 = 10 marks)

Illustrate the Insertion sorting with example unordered elements given to be as {34, 8, 64, 51, 32, 21};

- a) Depict the sorting iterations in a table accordingly.
- b) The Insertion sorting algorithm to sort N elements

- c) Mention the time complexity of this algorithm.

Question 17: (3 + 2 + 5 = 10 marks)

For an undirected weighted graph G as shown below; answer the following questions.

- Illustrate to find the minimal spanning tree using Kruskal's algorithm, by depicting in the table with columns as **edge, weight, action**.
- Draw the result of the **final stage graph ONLY**.
- Write the Kruskal's minimum spanning tree algorithm.

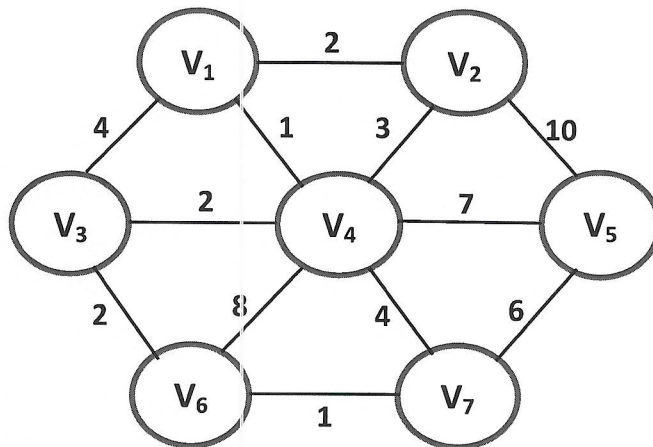


Fig: Initial Undirected Weighted Graph G

Question 18: (5 + 5 = 10 marks)

Taking a simple scheduling problem in algorithm design concept, how should a processor schedule jobs queued into a **SINGLE processor only**? With the table given below with respective jobs and times;

- Draw the scheduling diagram for the **normal schedule** and **explain**.
- Draw the scheduling diagram for a possible **better schedule** to get an optimal time completion and **explain**.

Table: Jobs and Times

Job	Time
j ₁	15
j ₂	08
j ₃	03
j ₄	10

End of Examination