



The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering

Study Programme : Bachelor of Science Honours in Engineering
Name of the Examination : Final Examination
Course Code and Title : EEX4435 - Data Structures and Algorithms
Academic Year : 2024/25
Date : 05th February 2026
Time : 13:30 – 16:30 h
Duration : 3 hours

General instructions

1. Read all instructions carefully before answering the questions.
 2. This question paper consists of **Five (5)** questions in **Four (4)** pages.
 3. Answer **all** questions.
 4. All questions carry equal marks.
 5. Answer for each question should commence from a new page.
 6. This is a Closed Book Test (CBT).
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Q1 [20 marks]

- (a) Consider Algorithm Q1 given below to answer the questions, from (i) to (iii). This algorithm takes as input an array A of length n and a natural number m , where the entries in A are natural numbers between 0 and $m - 1$. The first (i.e., L1) indicates the initialization of the variable B .

Algorithm Q1

```

L1:   $B = [0] \cdot m$ 
L2:  for  $i = 0$  to  $n - 1$  do
L3:     $B[A[i]] = B[A[i]] + 1$ 
L4:   $\ell = 0$ 
L5:  for  $j = 0$  to  $m - 1$  do
L6:    if  $B[j] > 0$  then
L7:      for  $k = 0$  to  $B[j] - 1$  do
L8:         $A[\ell + k] = j$ 
L9:       $\ell = \ell + B[j]$ 

```

- (i) After the line L3, what does the value $B[j]$ represent for $j \in \{0, \dots, m - 1\}$. [04]
(ii) Describe in a couple of sentences what this algorithm does. [04]
(iii) Provide the asymptotic runtime of this algorithm as a function of n and m , and justify your answer. [04]
- (b) Write briefly two differences between dynamic memory allocation and static memory allocation, stating the basis on which the difference is given. [04]
- (c) Using a 2D array as an example, briefly describe the two concepts: [04]
“Every data structure has a *logical view* and *implementation*”.

Q2 [20 marks]

- (a) Write the pseudocode algorithms for the following standard operations in stack data structure. State any assumptions you make. [06]
(i) *peek()* (ii) *isEmpty()* (iii) *isFull()*
- (b) Consider an arithmetic expression given by

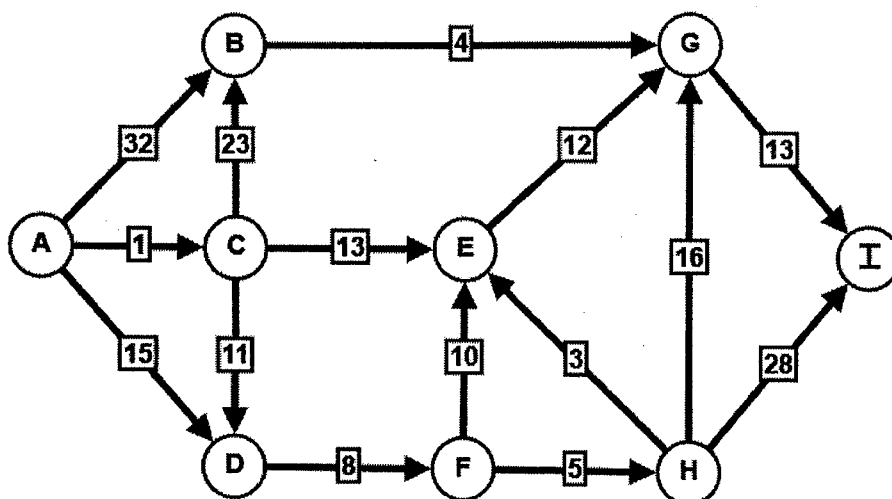
$$3 \times (9 + 8/2) + 2 - (6 - 1)^2$$

Evaluate the expression by showing the contents of the stack at every step, by creating the table with the column headers as shown below. [14]

Next symbol	Operand 1	Operand 2	Value	Stack

Q3 [20 marks]

- (a) Step through Dijkstra's algorithm, calculate the shortest paths from A to every other vertex. Show your steps in the table form. Cross out old values and write in new ones, from left to right, as the algorithm proceeds. [14]



- (b) When implementing, on what factors the time and space complexities of Dijkstra's algorithm depend, explain briefly and separately. [06]

Q4 [20 marks]

- (a) The list of numbers below is to be sorted into descending order.

650 431 245 643 455 134 710 234 162 452

Perform a Quick Sort to obtain the sorted list, giving the state of the list after each pass, indicating the pivot elements. [12]

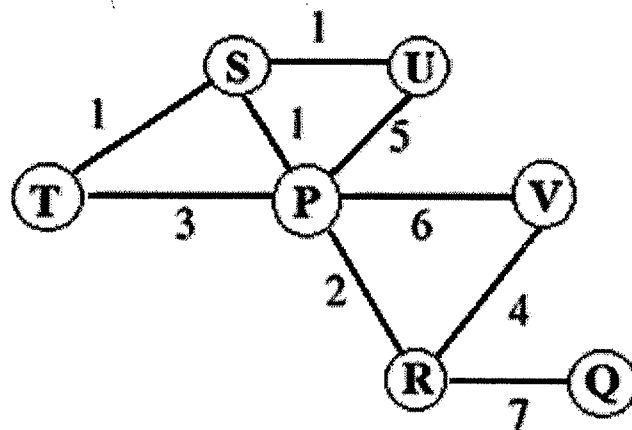
- (b) Suppose you have the following hash table, implemented using linear probing with the hash function, $h(x) = x$. Assume that the hash table has never been resized, and no elements have been deleted yet.

x	0	1	2	3	4	5	6	7	8
$h(x)$	9	18		12	3	14	4	21	

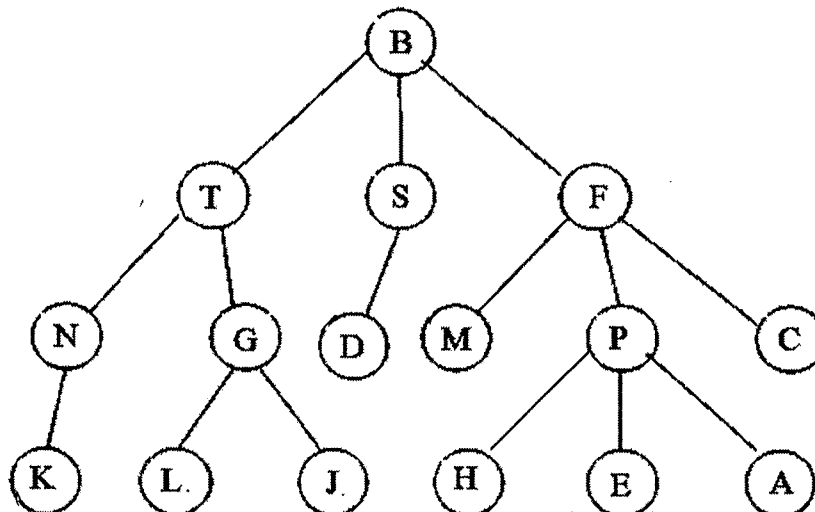
State in which order the elements have been added to this hash table, briefly explain your answer. [08]

Q5 [20 marks]

- (a) Consider the graph shown below. Starting at vertex **U**, obtain the list of the vertices that are visited in order by Depth First Search. Show all steps and write any assumption(s) you made. [14]



- (b) Consider the binary tree shown below. For each of the traversals listed, give the order in which the nodes are visited. [06]
- (i) Pre-order (ii) In-order (iii) Post-order



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