Patuakhali Science and Technology University
B.Sc. Engg. (CSE) 3rd Semester (Level-2, Semester-I) F removal Examination July-December 2019
Course code: CIT-211   Course Title: Data Structure and Algorithms
Session: 2015-16   Credit hour: 3.00   Full marks: 70   Duration: 3 hours

[Figures in the right margin indicate full marks. Split answering of any question is not recommended]

Answer any **5** of the following questions.

1. (a) ~~What does data structure mean?~~   2
   (b) ~~Write down the operations which are performed on linear data structure.~~   4
   (c) How to insert an ITEM into the Kth position in a linear array LA? Explain the representation   8
       of two-dimensional array in memory.

2. (a) What is linked list? Why it is important as a data structure?   2+2=4
   (b) How to insert an ITEM after a given node? Explain and write down the steps of algorithm.   6
   (c) Mention the scenarios of header linked list and circular linked list.   4

3. (a) Define binary tree, complete binary tree, and binary search tree.   6
   (b) Explain the representation of binary tree in memory. State the preorder traversal algorithm   6
       using stacks.
   (c) What are the properties of a general tree?   2

4. (a) Suppose Module A requires M units of time to be executed, where M is a constant. Find the   2+3=5
       complexity $C(n)$ of the following algorithms, where n is the input data and b is a positive integer.

Algorithm 1.1	Algorithm 1.2
1 Repeat for I=1 to N	1 Set J:=1
2 Repeat for J=1 to N	2 Repeat steps 3 and 5 while J≤N:
3 Repeat for K=1 to N	3 Repeat for L=1 to N
4 Module A.	4 Module A.
[End of step 3 loop]	[End of step 3 loop]
[End of step 2 loop]	5 Set J:=B×J
[End of step 1 loop]	6 Exit
5 Exit	

   (b) Briefly explain the following terms with respect to data structure and algorithm with proper example.   2+2=4
       i) Recursion
       ii) Algorithm and procedure.
   (c) Mention the operations of data structure. Sort the following array of elements by using radix sort   1+4=5
       algorithm.
       220,110, 99,143, 361, 423, 538, 128, 321, 543, 6

5. (a) Write a procedure to insert an element from top of the stack. Sort the following array of   2+3=5
       elements by using insertion sort algorithm.
       348, 143, 361, 423, 538, 128, 321, 543, 366
   (b) Compare BFS and DFS with examples and find out when to use which search technique.   2+2=4
   (c) Translate, by inspection and hand, each infix expression into its equivalent postfix   2+3=5
       expression:
       i) $(A + B \uparrow D/)/(E - F) + G$
       ii) $A * (B + D)/E - F * (G + H/K)$

6 A Define complete graph, neighbors, tree graph. Draw the graph for the given adjacency matrix.   3+2=5

0	5	3	0	0	0	6
5	0	0	6	0	7	0
3	0	0	0	8	6	0
0	6	0	0	0	0	7
0	8	0	0	0	3	0
0	7	6	0	3	0	0
6	0	7	0	0	0	0

(b) Explain overflow and underflow. Distinguish between linear and nonlinear data structure.   2+2=4
(c) Consider the following figure A2, find a minimum path P from A to J using BFS where each edge has length 1.   5
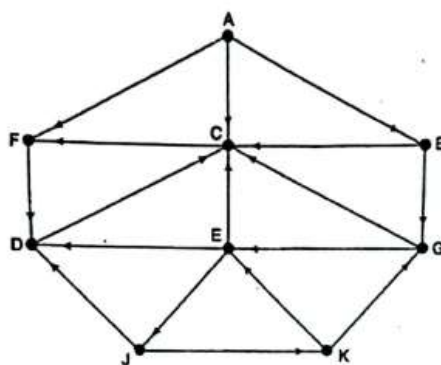

Figure: A2

J = Base(w) + Loe

Patuakhali Science and Technology University
Semester (Level-2, Semester-1) B.Sc. Engg. (CSE) Final Examination-2022 (January-June)
Course Code: CIT-211 Course Title: Data Structures and Algorithms
### Credit Hour: 3.00 Session: 2020-21 Full Marks:70 Duration: 3 Hours

[Figure in the right margin indicates full marks. Split answering of any question is not recommended.]
*Answer any 5 of the following questions. The answer must be **brief, relevant, and neat**.*

a) Define the following terms in your own words. Data, Entity, Attributes, Records, and Data Structure. Explain algorithm complexity, a time-space tradeoff. **3**

b) Demonstrate the general representation of multi-dimensional arrays in memory. Suppose an 11-element array A contains the values $a_1, a_2 ...., a_{11}$. Find the values in A after each loop. **2+4=6**

   i) Repeat for K=1 to 10
       Set A [K+1]:= A [K].
       [End of loop.]

   ii) Repeat for K=10 to 1 by -1:
       Set A [K+1]:= A [9].
       [End of loop.]

   $A[10] = A[9]$ sets $A[10] = a_9$
   $A[9] = A[8]$ sets $A[9] = a_8$

c) State the steps of the binary search algorithm. What are the limitations of the binary search algorithm? Suppose the following numbers are stored in an array A: 32, 51, 27, 85, 66, 23, 13, 57. **2+3=5**
   $A_1 \ A_2 \ A_3 \ A_4 \ A_5 \ A_6 \ A_7 \ A_8$
   You are asked to apply the bubble sort algorithm to array A and discuss each pass separately.

2. a) What is list? Give an example of a list with several items where a few items are deleted from the list and some new items are inserted into the list. Mention the disadvantages of an array. How to recover them using a linked list. Show the representation of the linked list in memory including the free-storage list. **3+4=7**

   b) Distinguish between overflow and underflow in a linked list. Let LIST be a linked list in memory with successive nodes A and B and node N is to be into the list between A and B. Show the schematic diagram of such an insertion operation. Write a procedure or algorithm to insert an ITEM after a given node A and before node B. Draw a schematic diagram of the two-way list. **2+5=7**

3. a) Define and demonstrate the following terms in your own words. Binary tree, Complete binary tree, Extended binary tree, and Depth of a tree. Show the linked representation of the binary tree in memory. **3+2=5**

   b) Consider the following tree T, you are asked to simulate the preorder traversal algorithm with T and show the content of STACK at each step. **4**

Tree, T
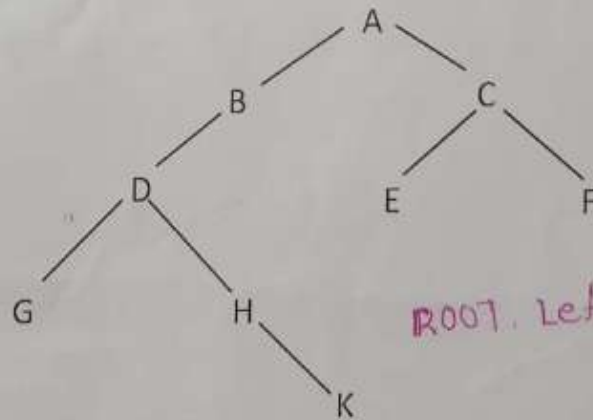
ROOT. Left, Right

c) Write the formal insertion procedure of heap, INSHEAP (TREE, N, ITEM). Build a heap H from the numbers: 44, 30, 50, 22, 60, 55, 77, 55) Suppose a binary tree can have three cases in its nodes. How to delete an item from different cases in a binary search tree?   2+3=5

4. a)   i) Mention the basis of linearity and nonlinearity of data structure with examples.   3+2
   ii) Write an algorithm for inserting an element in a stack.
   b) Consider the infix expression: $Q = 12/(7-3) + 2*(1+5)$ $3 + 12 = 15$ 2+3
   i) Translate Q, by inspection and hand, into its equivalent postfix expression P.
   ii) Evaluate the postfix expression.

c) Consider the following queue of characters, where QUEUE is a circular array which is alloc
six memory cells: FRONT = 2, REAR = 4   QUEUE: _ _ _ A, C, D, _ _
(For notational convenience, we use " _ "to denote an empty memory cell.) Describe the queue as
the following operations take place:

|	
(a) F is added to the queue.	(e) R is added to the queue.
(b) Two letters are deleted.	(f) Two letters are deleted.
(c) K. L and M are added to the queue.	(g) S is added to the queue.
(d) Two letters are deleted.	(h) Two letters are deleted.

−,−,−,S,− −

5. a) Show the recursive solution to Towers of Hanoi problem for n=3. Also calculate the complexity with respect to your solution.   2.5+1.5

b)   i)   Distinguish between recursion and iteration.   2+3

    ii)   Write the algorithm to find out Fibonacci sequence. Explain in details the working sequence of your algorithm to find out fifth Fibonacci.

c)   i)   Sort the following array of elements by using selection/radix sort algorithm.   3+2

       504, 3, 361, 423, 538. 128, 421, 43, 66   R = LOe=

    ii)   Mention the complexity of quick sort, insertion sort, radix sort and merging.

6. a)   i)   Define finite graph, tree graph, and strongly connected graph with illustration.   2+2

    ii)   What do you understand by Big Oh, Omega and Theta asymptotic notations?

b) Consider the following bus schedule of a bus operator company.   2+3

Bus No.	Station (Source)	Station (Destina.)	Sample Fare	Bus No.	Station (Source)	Station (Destina.)	Sample Fare
1003	Patuakhali	Dhaka	650	3001	Gazipur	Cox's Bazar	1000
1006	Dhaka	Patuakhali	600	3005	Khulna	Chattogram	1000
2001	Barishal	Khulna	500	3008	Chattogram	Barishal	950
2003	Barishal	Gazipur	700	4002	Cox's Bazar	Khulna	1200
2004	Gazipur	Barishal	650	4005	Cox's Bazar	Barishal	1150

    i)   Draw a labeled weighted graph considering the above bus schedule.

    ii)   Also show the linked representation of the graph.

c)   i)   Find out the topological sorting of the following graph.

c) i) ~~show the linked~~ representation of the graph.
Find out the topological sorting of the following graph.

2.5+2.5
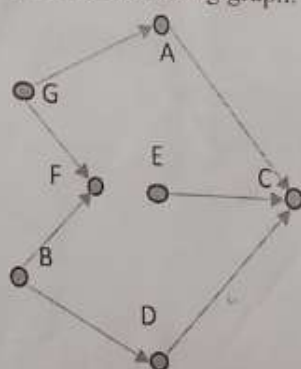
ii) Consider the following figure, find a minimum path P from A to K using BFS where each edge has length 1.
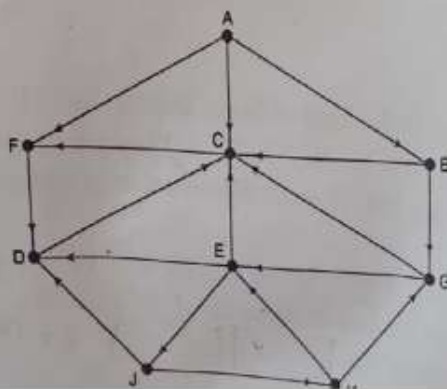
[Figures in the right margin indicate full marks. **Split answering of any question is not recommended. Write the full question number e.g. 1(B) (II) before the answer paragraph]**

Answer any 5 of the following questions

1 a Suppose the following numbers are stored in an array A: 07
32, 51, 27, 85. 66, 23, 13, 57
Apply the bubble sort to the array A and discuss each pass separately.

1 b Consider the linear arrays AAA(5:50), BBB(-5: 10) and CCC(18).   07

 i. Find the number of elements in each array.
 ii. Suppose Base (AAA) = 300 and w = 4 words per memory cell for AAA. Find
  the address of AAA [15], AAA[35] and AAA[55].

2 a Suppose a company keeps a linear array YEAR(1920: 1970) such that YEAR[KJ
contains the number of employees born in year K. Write a module for each of the   07
following tasks:

 i. To print each of the years in which no employee was born.
 ii. To find the number NNN of years in which no employee was born.
 iii. To find the number N50 of employees who will be at least 50 years old at the
  end of the year. (Assume 1984 is the current year.)
 iv. To find the number NL of employees who will be at least L years old at the end
  of the year. (Assume 1984 is the current year.)

2 b A hospital maintains a patient file in which each record contains the following data: 07
Name, Admission Date, Social Security Number, Room, Bed Number, Doctor

 i. Which Items can serve as primary keys?
 ii. Which pair of items can serve as a primary key?
 iii. Which Items can be group items?

3 a Discuss whether a stack or a queue is the appropriate structure for determining the order   07
in which elements are processed in each of the following situations.

 i. Batch computer programs are submitted to the computer center.
 ii. Program A calls subprogram B, which calls subprogram C, and so on.
 iii. Employees have a contract which calls for a seniority system for hiring and
  firing.   07

3 b Write an algorithm for Linear Search.

4 a) Sort the following array of elements by using radix sort algorithm. 4

      48, 243, 10, 423, 538, 128, 321, 543, 200

  b) Give the advantages and disadvantages of two way list over one way list. Give the header linked 4
list representation of the following polynomial equation.

$$p(x, y, z) = 2x^8y^7 - 5x^7y^3 + 5y^2 - 6xz + 4$$

  c) Define header linked list. Write an algorithm to find out the number of times a given item 6
occurs in a linked list.

5 a) Compare BFS and DFS with examples and find out when to use which search 4
technique.

  b) Translate, by inspection and hand, each infix expression into its equivalent postfix 4
expression:

      i) $(A + B \uparrow D) / (E - F) + G$

      ii) $A * (B + D) / E - F * (G + H / K)$

  c)   i)   Make a minheap from the following list of elements. 6
          44, 30, 50, 22, 50, 77,

      ii)   Build a Huffman tree from the list of elements.

Item	A	B	C	D	E	F
Weight	4	15	25	5	8	16

6 a) Define binary tree and 2-tree. Simulate (step by step processing) the inorder traversing mechanism 5
of the following tree.
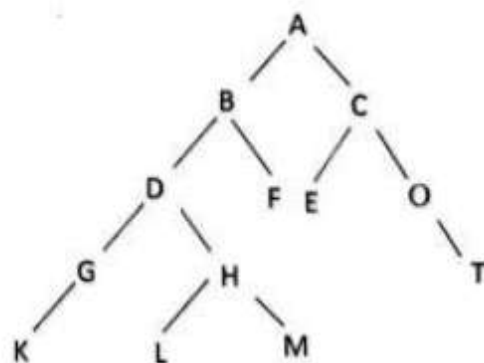
  b) Write an algorithm to delete a node with a given ITEM of information. 5

  c) What is garbage collection? Analyze the complexity of quick sort. 4

Code: CIT-211   Course Title: Data Structures Algorithms

1.00 Hour   [Answer all the following questions]   Marks – 15

1. What is linear data structure? Demonstrate the two-dimensional array in memory. Compare the complexity   8
    of linear and binary searching algorithms. Suppose LA is a linear Array with N elements and K is the
    positive integer such that K is less than equal to N. Write an algorithm that inserts an ITEM into Kth
    position in LA.

2. How does the computer evaluate the following infix expression: $10*(12+4)-24/8$? Explain it in detail.   7
    Suppose S consists of the following n=5 letters: S=A B C D E. Find the number C of comparisons to sort S
    using quicksort. Is there any general conclusion? Define recursion with an example. Write the procedure to
    insert an ITEM into a queue.

[Figure in the right margin indicates full marks. Split answering of any question is not recommended.]
Answer any 5 of the following questions. The answer must be *brief, relevant, and neat.*

1. a) What is data structure? Briefly explain the operations of data structure. **3**
   b) Define the linear data structure. Demonstrate the representation of linear array in memory. **2+4=6**
   Write an algorithm INSERT (LA, N, K, ITEM), where LA is a linear array with N elements
   and K is a positive integer such that K is less than or equal to N. This algorithm inserts an
   element ITEM into the Kth position in LA.
   c) Mention the sorting principle of the bubble sort algorithm. Suppose the following numbers **1+4=5**
   are stored in an array A: 32, 51, 27, 85, 66, 23, 13, 57. You are asked to apply the bubble
   sort algorithm to array A and discuss each pass separately.

2. a) Draw a schematic diagram of nodes in a linked list. Show the representation of linked list in **2+3=5**
   memory including free-storage list.
   b) What is garbage collection in linked list? Write a procedure or algorithm to delete an ITEM **2+4=6**
   after a given node A and before node B.
   c) Distinguish between grounded header list and circular header list. Draw a schematic diagram **3**
   of the two-way list.

3. a) What is binary tree? Show the sequential representation of the binary tree in memory. **2+2=4**
   b) Suppose, a tree is presented by T and you are asked to simulate the inorder traversal **6**
   algorithm with T and show the content of STACK at each step.
   c) What is the general tree? Write the formal insertion procedure of binary search tree, **1+3=4**
   INSHEAP (TREE, N, ITEM). Build a binary search tree T from the numbers: 44, 30, 50, 22,
   60, 55, 77, 55.

4. a) i) Sort the following array of elements by using selection sort algorithm. **3+2**
   348, 143, 361, 423, 538, 128, 321, 543, 366
   ii) Distinguish between stack and queue with application
   b) i) Suppose S is the following list of 10 alphabetic characters: **3+2**
      PATUAKHALI
   The characters in S are to be sorted alphabetically. Use the quicksort algorithm to find the
   final position of the first character P.
   ii) Analyze the complexity of quick sort algorithm.
   c) Translate, by inspection and hand, each infix expression into its equivalent postfix **2+2**
   expression:
   i) $(A + B \uparrow D)/(E - F) + G$
   ii) $A * (B + D)/E - F * (G + H/K)$

5. a) i) State two different data structure for representing graphs. **3+2**
   ii) Suppose the nodes of the figure A1 are stored in memory. Find the adjacency matrix A of
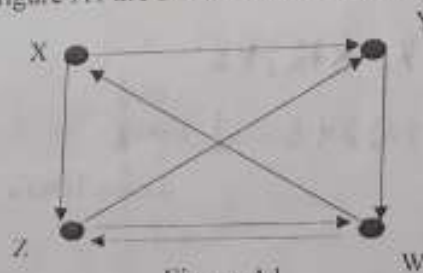   the graph G.

Figure A1

b) i) A graph G is stored in memory as follows:

NODE	A	B		E		D	C	
						0	2	3
NEXT	7	4	0	6	8	7	9	
ADJ	1	2		5				8
	1	2	3	4	5	6	7	

START=1, AVAILN=5

DEST	2	6	4		6	7	4	4	4	6
									0	0
LINK	10	3	6	0	0	0	0	4	0	0
					5	6	7	8	9	10
	1	2	3	4						

AVAIL=8

Draw the graph G.

b) Distinguish between linear and nonlinear data structure.   2+2

c) i) Show that the sum of the degree of all the vertices in a graph is always even.
    ii) Briefly explain the terms "Algorithm and procedure" with respect to data structure and algorithm.

5

6. a) Give the advantages and disadvantages of recursion. Justify the following statements
    i) Each time a procedure calls itself, it must be nearer in some sense to solution
    ii) Recursion functions are always fast and use less memory

2.5+2.5

b) i) Consider the following weight matrix W.

$$W = \begin{pmatrix} 7 & 5 & 0 & 0 \\ 7 & 0 & 0 & 2 \\ 0 & 3 & 0 & 0 \\ 4 & 0 & 1 & 0 \end{pmatrix}$$

Draw weighted graph G.

ii) Write down the Warshall's algorithm.

c) i) Define multigraph and complete graph.   2+2
    ii) Let J and K be integers and suppose Q(J, K) is recursively defined by

$$Q(J,K) = \begin{cases} 5 & : if \ J < K \\ Q(J - K, K + 2) + j & : if \ J \geq K \end{cases}$$

Find Q(10,7) and Q(7,3)

Q(10,7) we have J ≥ K So we must
use the second case of the recursive definition.

Q(10,7) = Q(10-7, 7+2)+5
    = Q(3,9)+5 [use the first case of the recursive
                   definition, since 3<9]
    = 5+5
    = 10

LOC(LA[K] = Base (LA) + W (K- lower bound

[Figure in the right margin indicates full marks. Split answering of any question is not recommended.]
Answer any 5 of the following questions. Answer must be **brief, relevant and neat**.

1. (a) Define the following terms in your own words. Data, Entity, Attributes, Records, and Data structure.   3

(b) What is linear array? Demonstrate the representation of linear array in memory. Suppose a 10-element array A contains the values $a_1, a_2, \ldots, a_{10}$. Find the values in A after each loop.   2+4

    i)   Repeat for K=1 to 9
          Set A [K+1]:= A [K].
          [End of loop.]

    ii)   Repeat for K=9 to 1 by -1:
          Set A [K+1]:= A [9].
          [End of loop.]

(c) Mention the sorting principle of bubble sort algorithm. Suppose the following numbers are stored in an array A: 32, 51, 27, 85, 66, 23, 13, 57. You are asked to apply the bubble sort algorithm to the array A and discuss each pass separately.   1+4

2. (a) What are the disadvantages of array? How to recover them using linked list. Show the representation of linked list in memory including free-storage list.   2+3

(b) Distinguish between overflow and underflow in a linked list. Let LIST be a linked list in memory with successive nodes A and B and node N is to be into the list between A and B. Show the schematic diagram of such an insertion operation. Write a procedure or algorithm to insert an ITEM after a given node A and before node B.   2+4

(c) What is header linked list? Draw a schematic diagram of the two-way list.   3

3. (a) Define and demonstrate the following terms in your own words. Binary tree, Complete binary tree, Extended binary tree, and Depth of a tree. Show the sequential representation of binary tree in memory.   4+2

(b) Consider the following tree T, you are asked to simulate the preorder traversal algorithm with T and show the content of STACK at each step.   4

Fig: Tree, T
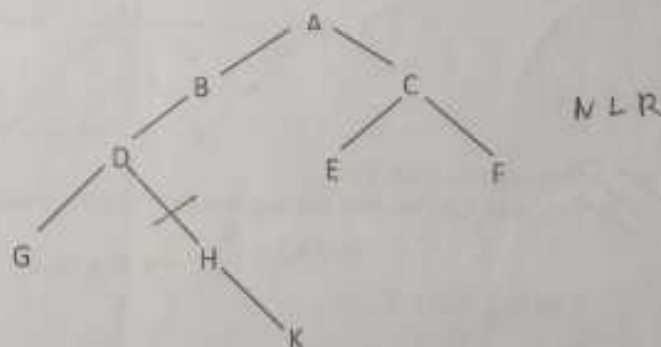
(c) What is the property of binary search tree? Write the formal insertion procedure of heap, INSHEAP (TREE, N, ITEM). Build a heap H from the numbers: 44, 30, 50, 22, 60, 55, 77, 55   1+3

4. (a) Explain divide and conquer algorithms with example.   3

(b) i. Translate by inspection and hand, following infix expression into its equivalent prefix expression: (A-B)*(D/E)   2+2

    ii. Write the algorithm to insert an element into a queue.

(c) Evaluate the following postfix expression using algorithmic steps.   3

$$P: 3, 1, +, 2, \uparrow, 7, 4, -, 2, *, +, 5, -$$

(d) Consider the following weight matrix W.   4

$$W = \begin{pmatrix} 7 & 5 & 0 & 0 \\ 7 & 0 & 0 & 2 \\ 0 & 3 & 0 & 0 \\ 4 & 0 & 1 & 0 \end{pmatrix}$$

Draw weighted graph G. Apply modified Warshall's algorithm to find the shortest path Q.

5. a) A graph G is stored in memory as follows:

NODE	A	B		E		D	C	
NEXT	7	4	0	6	8	0	2	3
ADJ	1	2		5		7	9	
	1	2	3	4	5	6	7	8

START=1, AVAILN=5

DEST	2	6	4		6	7	4			
LINK	10	3	6	0	0	0	0	4	4	6
	1	2	3	4	5	6	7	8	9	10

AVAILE=8

Draw the graph G.

b) Define complete graph and multigraph. Suppose the nodes of the figure A are stored in memory. **1+3**
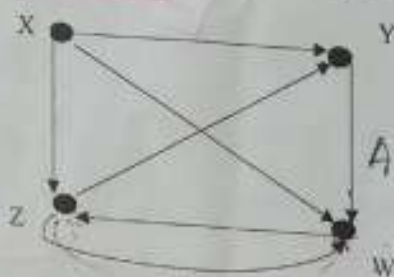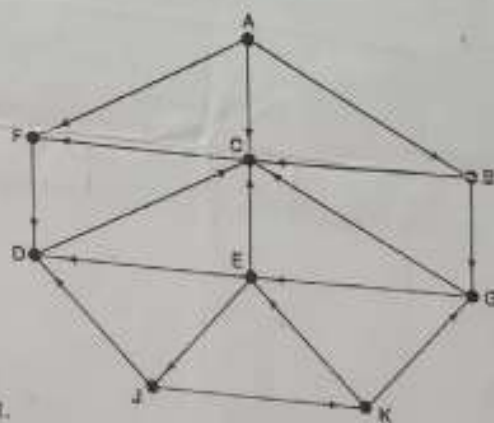

$$A = \begin{array}{c} X \\ Y \\ Z \\ W \end{array} \begin{bmatrix} 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{array}{cccc} X & Y & Z & W \end{array}$$

Figure A1

Give the adjacency matrix A of the graph G. Calculate the path matrix P of G. $B_N = A + A^2 + A^3 + A^4$

c) Consider the following figure. Find and print all the nodes reachable from the node A using DFS. **3**

d) i) Define topological sort.

ii) Let J and K be integers and suppose Q(J, K) is recursively defined by **1.5+2.5**

$$Q(J, K) = \begin{cases} 5 & : if\ J < K \\ Q(J - K, K + 2) + J & : if\ J \ge K \end{cases}$$

Find Q(2,7) and Q(5,3)

6. a) Briefly explain the following terms with respect to data structure and algorithm. **3**
   i) Pseudocode
   ii) Algorithm and procedure

b) i) Give the short notes on Constant time and Logarithmic time complexity with example. **2+2**
   ii) Calculate the complexity of the following segment of code.

```
sum = 0;
for (i=0; i<n*n; i++)
    sum++;
```
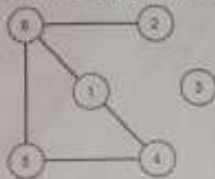
c) Sort the following array of elements by using insertion sort algorithm.

348, 143, 361, 423, 538, 128, 321, 543, 366   Ch-9

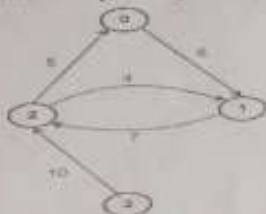d) Write the algorithm for merging two sorted arrays. Ch-9 **3**

20

1 Make adjacency matrix for the following graph.

"OR"
Make adjacency matrix for the following graph.

2 Write a program for sorting (as per your knowledge) the following elements in both ascending and descending   20
way.

$$-999, 01, 15, 912, 40, 17, 25, 751, 23$$

20

3 Write a program to complete the following matrix multiplication using array.

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \times \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix} = ?$$

Where users have to give the inputs. *If you able to control the matrix dimension, you will get bonus marks.*

Course Code: CIT-211

Time: 50 minutes

Course Title: Data Structure and Algorithms

Marks: 15

Distinguish linear and nonlinear data structure. Suppose LA is a linear array with N   4
elements and K is a positive integer such that K ≤ N. Write an algorithm that inserts
an element ITEM into the Kth position in LA.

Illustrate the representation of a two-dimensional array in memory and formulate the   5
related formula. What is the limitation of the binary search algorithm? Write the binary
search algorithm. Compare the complexity of linear and binary search algorithms.

Write a procedure to PUSH an element to stack.-2.   2

Using algorithmic steps for transforming the following Infix expression into its
equivalent postfix expression. --   A-B/D/(E-F)*G)

Patuakhall Science and Technology University
3rd Semester (Level-2, Semester-1) B.Sc.Engg.(CSE) Final Examination-2020 (January-June)
Course Code: CIT-211 Course Title : Data Structures and Algorithms
Credit Hour : 3.00   Session: 2018-19   Full Marks:70   Duration: 3 Hours

[Figure in the right margin indicates full marks. Split answering of any question is not recommended.]
Answer any 5 of the following questions. Answer must be brief, relevant and neat.

1 a) Define data structure. Mention the operations of data structures.   3
   b) Suppose a data set S contains n elements.   2+2
       i) Compare the running time T_1 of the linear search algorithm with the running time T_2 of the
           binary search algorithm when n=1000 and n = 10000.
       ii) Discuss searching for a given item in S when S is stored as a linked list.
   c) Briefly explain the following terms with respect to data structure and algorithm.   3
       i) Time-space tradeoff   ii) Algorithm and procedure   iii) Big O notation
   d) Define overflow. Sort the following array of elements by using insertion/ radix sort algorithm.   1+3
       804, 143, 361, 423, 538, 128, 321, 543, 366

2 a) Translate. by inspection and hand, each infix expression into its equivalent prefix expression: 1+2
       i)   (A-B)*(D/E)
       ii) (A+B ↑ D)/(E-F) + G   C E M O P R S T U
   b) Explain divide-and-conquer procedure. Differentiate between recursion and iteration.   2+2
   c) Suppose S is the following list of 15 alphabetic characters: 3
                        COMPUTER SCIENCE
       The characters in S are to be sorted alphabetically. Use the quicksort algorithm to find the
       final position of the first character C.
   d) Consider the following queue of characters, where QUEUE is a circular array which is   4
       allocated six memory cells: FRONT = 2, REAR = 4   QUEUE: _ _ A, C, D, _ _
       (For notational convenience, we use " "to denote an empty memory cell.) Describe the
       queue as the following operations take place:

(a) F is added to the queue. - - A c D F	(e) R is added to the queue.
(b) Two letters are deleted.	(f) Two letters are deleted.
(c) K. L and M are added to the queue.	(g) S is added to the queue.
(d) Two letters are deleted.	(h) Two letters are deleted.

3 a) Write an algorithm to find the shortest path from a weighted graph.   3
   b) Define finite graph and multi graph. Distinguish between BFS and DFS.   2+2
   c) Consider the following figure A2, find a minimum path P from A to K using BFS where   3
       each edge has length 1.

Breadth

Deapth

d) i) Consider the (directed) graph G from the following figure A1. (a) Find all the simple path, from Y to Z. (c) Find indeg(Y) and outdeg(Y) (d) Are there any sources or sinks?

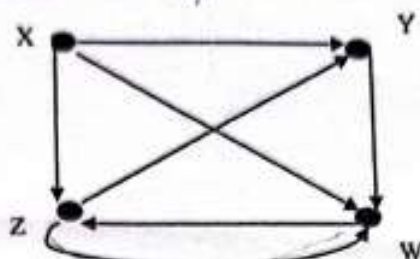ii) Suppose the nodes of the figure A are stored in memory. Find the adjacency matrix A of the graph G.

Figure A1

4. a) What is the difference between linear and non-linear data structure? **2**

b) Suppose a 10-element array A contains the values $a_1, a_2 ....., a10$. Find the values in A after each loop. **4**

    i)   Repeat for K=1 to 9
        Set A [K+1]:= A [K].
        [End of loop.]

    ii)   Repeat for K=9 to 1 by -1:
        Set A [K+1]:= A [9].
        [End of loop.]

c) Suppose multidimensional array A and B are declared using A(-2:2, 2:22) and B(1:8, -5:5, -10:5) **4**

    i)   Find the length of the each dimension and the number of elements in A and B.

    ii)   Consider the element B [3, 3, 3] in B. Find the effective indices E1, E2, E3, and the address of the element, assuming Base (B) = 400 and there are w = 4 words per memory location.

d) Modify the binary search algorithm, so that it becomes a search and insertion algorithm. **4**

5. a) What are the disadvantages of array? How to recover them using linked list? **2+2=4**

b) Let LIST be a linked list in memory. Write a procedure **5**

    i)   Finds the number NUM of times a given ITEM occurs in LIST

    ii)   Finds the number NUM of nonzero elements in LIST

    iii)   Adds a given value K to each element in the LIST.

c) Suppose LIST is a linked list in memory. Write an algorithm which deletes the last node from the LIST. **3**

d) What is two-way list? Draw a schematic diagram of the two-way list. **2**

6. a) Define in your own words the following terms: binary tree, ancestor of a node, descendant of a node, depth of a tree. Write the preorder traversal algorithm. **4+3=7**

b) A binary tree has 9 nodes. The inorder and preorder traversals of T yield the following sequences of nodes: Inorder: E A C K F H D B G and Preorder: F A E K C D H G B Draw the T. **3**

c) Write the formal insertion procedure of heap, INSHEAP (TREE, N, ITEM). Build a heap H from the numbers: 44, 30, 50, 22, 60, 55, 77, 55. **4**

Credit hours: 3.00   Full marks: 70   Duration: 3 hours
[Figures in the right margin indicate full marks.]
Answer any 7 of the following questions. Split answering is not recommended.

1 a. Demonstrate insertion and deletion of an item into an array. (Algorithm)   6
   b. If you have an array with length *n* and you want to insert a value at position *p*, how many times   4
       you have to move the data of the current array? Similarly, how many times you have to move the
       data of the array with length *n* if you want to delete the element at position *p*? (code)

2. a. What are the fundamental characteristics of arrays and linked lists?   5
   b. Discuss with example how you can insert an item in sorted order into a linked list.   5

3 a. Provide two examples of each of the applications of queues and stacks.   4
   b. What are the operations on Queues? Discuss with example in short.   6

4. a. When is binary search better than linear search and when is linear search better than binary   5
       search? Explain with example.
   b. Apply binary search on the following list to search 13.   5
                       1 2 5 8 9 10 13 15 17

5 a. Draw the graph for the given adjacency matrix.   4

   b. Apply BFS and DFS on the graph you get in the answer to the question   6
       no. 5.a. Start from node A and stop when you find node E. Show step-by-
       step demonstration of BFS and DFS.

6 a. What are the characteristics of a Binary Search Tree (BST)?   2
   b. Construct a BST with the following data. Show each step   5
                       10 13 8 5 3 18 20 1 6 16 25
   c. How can you achieve sorted output from a Binary Search Tree? Explain with example.   3

7 a. Construct the adjacency matrix for the graph given.   2

   b. Apply Dijkstra's algorithm on the same graph of   8
       question 7.a. with Frankfurt being the start node.
       Show step-by-step demonstration of the algorithm.
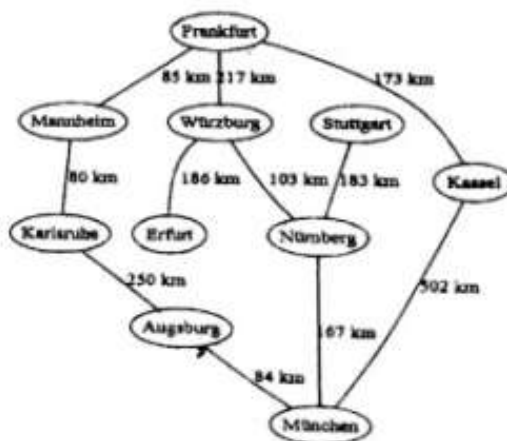
8. Demonstrate how bubble sort works on the following data set. Show each iteration with sub-   10
   iterations.
                       5 1 4 2 8

9. Show the generation of the Huffman tree using Huffman encoding algorithm on the following   10
   text and then encode the text.
                       WAS IT A CAR OR A CAT I SAW?