COMSATS University Islamabad, Lahore Campus

Terminal Examination –FALL 2023

Course Title:	Data Structures & Algorithms				Course Code:	CSC 211	Credit Hours: 4(3,1)
Course Instructor/s:	Imran Latif, Rizwan Qureshi, Humera Faisal, Asmara Safdar, Ms. Sania, Ahmad Arsalan				Program Name:	BCS, BSE	
Semester:	3rd	Batch:	BCS, BSE	Section:	All	Date:	1 / Jun / 24
Time Allowed:	**180 minutes**				**Maximum Marks:**		**100**
Student's Name:	[redacted]				Reg. No.	CIIT/-	[redacted]

Important Instructions / Guidelines:

- You can use any of the C, C++, or Java programming languages.

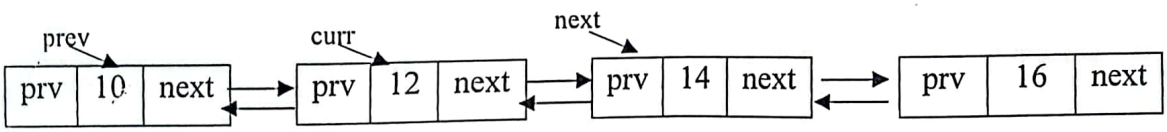
Question 1: Lists **Marks: [5+5+5+5=20]**

CLO: <1>; Bloom Taxonomy Level: <Applying>

A.

Write a few lines of code that will convert the above list into a circular linked list.

B.



Draw above linked list after following lines of code are run:

```
Node p;
p=next.next
curr.next = p
p.prv = curr
```

C.

Suppose there needs to be a system that does frequent addition and removal of elements from both the beginning and the end of a collection. What type of data structures do you suggest would be best for that and justify your answer in a few lines.

D.

Consider we need to store 1M integers (1 integer=4bytes) in a memory where memory blocks are available in multiple fragments (maximum fragment size=10,000 bytes). Identify the most suitable data structures for solving this problem and justify your answer.

Question 2: Stacks and Queues **Marks: [5+5+5 = 15]**

CLO: <1>; Bloom Taxonomy Level: <Applying>

A.

Convert `(8+2-1*(7-3/2)*2)` into a postfix expression show the stack and output at each step

B.

Consider a stack that is allocated 8 memory cells. Draw the latest forms of stack after each of the given operations.

initial form of STACK : `A, C, D, F, J, K, ____, _____.`

operations to perform: `POP (), POP(), PUSH(L), PUSH(P), POP(), PUSH(R), PUSH(S), POP()`

C.

Take the final form of the stack in B above and pop the values one by one and enqueue them sequentially into a queue. Then consider the following operations on the queue.

```
q.enqueue(X)
q.enqueue(Y)
q.enqueue(Z)
q.dequeue() // d1
q.enqueue(N)
q.enqueue(O)
q.dequeue() // d2
q.dequeue() // d3
q.enqueue(G)
q.enqueue(H)
```

Draw final form of queue and write all the dequeued elements in a sequence (given in comment lines d1, d2, d3)

Question3: Trees (BST,IIeap) **[5+5+10+5+5=30MARKS]**

CLO: <2>; Bloom Taxonomy Level: <Applying>

For question A and B construct a max heap from given values.

46, 28, 11, 7, 4, 44, 5, 28, 30, 3

A. Draw a corresponding array of the heap.

Index	0	1	2	3	4	5	6	7	8	9	10	11
Data												

B. Show the contents of the array after **100** is inserted into the heap.

Index	0	1	2	3	4	5	6	7	8	9	10	11
Data												

C. Starting from an empty height balanced tree, insert the following data one-by-one in the sequence as given; ensure that the insertion of each node results in a height balanced tree. Show the step-by-step procedure by drawing the AVL Tree after each insertion.

50, 40, 20, 30, 10, 25, 45

D. Convert the following post-order traversal into Pre-Order Traversal. Also generate the binary search tree for these traversals.

Post-Order Traversal: 32 43 38 53 58 56 50 71 66 78 82 75 60

E. Suppose we want to search for number 292. Which of the following sequences could not be the sequence of nodes examined? BST is already formed. Also draw the trees to verify your answer:

a. 200, 252, 401, 398, 260, 280, 299, 292
b. 825, 202, 811, 240, 812, 245, 271,292
c. 912, 220, 911, 244, 898, 258, 362, 292

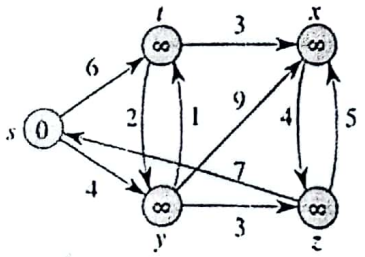
Question4: Graphs **[10+10+5=25 Marks]**

CLO: <2>; Bloom Taxonomy Level: <Applying>

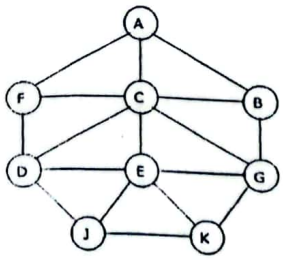
A. For the given adjacency matrix, construct a graph and draw the list representation.

	A	B	C	D	E	F	G
A	0	3	6	∝	∝	∝	∝
B	3	0	2	4	∝	∝	∝
C	6	2	0	1	4	2	∝
D	∝	4	1	0	2	∝	4
E	∝	∝	4	2	0	2	1
F	∝	∝	2	∝	2	0	1
G	∝	∝	∝	4	1	1	0

B. Using the following graph find the shortest path (Start vertex S) by dijkstra's algorithm also showing each step of the algorithm.



C. Traverse the graph shown below in Breadth first order starting from C vertex.



Question4: **[5+5=10 MARKS]**

CLO: <3>; Bloom Taxonomy Level: <Analyzing>

A. You are working on a system where data points continuously arrive in real-time, and you need to maintain a sorted order dynamically. Which sorting algorithm would be suitable for an online, dynamic environment? Discuss the challenges and considerations for adapting a sorting algorithm to handle incoming data points on-the-fly.

unsorted_array_online = [45, 21, 35, 58, 10, 72, 89, 14, 27, 50]

B. Write computing time for following algorithm in terms of computing size n.

```
n = read input from user
sum = 0
i = 0
while i < n
    number = read input from user
    sum = sum + number
    i = i + 1
end while

mean = sum / n
```