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## Thapar Institute of Engineering & Technology

## Department of Computer Science and Engineering

## **AUXILIARY EXAMINATION**

B. E. (2nd Yr. COE/CSE)

21st Feb., 2025

Friday, Time- 5:30 PM To 8:30 PM Time: 3 Hours, Max Marks: 100 Course Code: UCS301

Course Name: Data Structures

Name of Faculty: Tarunpreet Bhatia

Note: Attempt all the Questions in serial order. Answer all sub-parts of each question at one place. Do mention Page No. of your attempt at front page of your answer sheet. Assume missing data (if any).

Q.No	Questions	MM	CO	BL
Q.1	(a) Demonstrate the insertion sort results for each insertion for the following initial array of elements. A= [25, 6, 15, 12, 8, 34, 9, 18, 2]. Show the result after each pass.	(5)	CO2	L2
	(b) Given two sorted arrays A and B having numbers of elements m and n, respectively. Write a pseudo-code/algorithm of linear time complexity to merge A and B into a third array C, such that C is also sorted and having m + n number of elements. Show the working of your designed algorithm on the following array: A[] = $\{5, 8, 9\}$ , B[] = $\{4, 7, 8\}$ , C[]= $\{4, 5, 7, 8, 8, 9\}$ .	(10)	CO2	L2
Q.2	(a) Write an algorithm/pseudocode to print all the elements at the index of multiples of k with the first element assumed to have an index of 0. Do this for a single pass of the linked list. Input: $k=3$ , $12 -> 15 -> 18 -> 17 -> 19 -> 20 -> 22 -> NULL Output: 12 -> 17 -> 22 -> NULL$	(4)	CO1	L2
	(b) Extend the above solution algorithm assuming that the list is circular and the N <sup>th</sup> index is the same as 0 <sup>th</sup> index. You may need multiple passes. However, every number should be printed only once during its first selection. Input: k=3, 12 -> 15 -> 18 -> 17 -> 19 -> 20 -> 22 -> NULL Output: 12 -> 17 -> 22 -> 18 -> 20 -> 15 -> 19 -> NULL	(6)	CO1	L2
Q.3	You are given a weighted directed graph $G = (V, E)$ , where each node $v \in V$ represents a city, and each directed edge $e \in E$ represents a road connection between two cities. Every directed edge $e$ has a positive weight $w(e)>0$ , which indicates the travel cost for that road (such as toll fees, fuel costs, etc.). Additionally, each node $v$ has an associated visitation $cost c(v)>0$ , representing expenses incurred while visiting that city (e.g., lodging, food, or miscellaneous costs). Your task is to plan a trip from a source city $A \in V$ to a destination city $F \in V$ while minimizing the total trip cost using Dijkstra's algorithm. The trip cost includes:  a) The sum of edge weights along the path from $s$ to $t$ , representing travel costs.  b) The sum of visitation costs for all intermediate cities in the path (i.e., all cities visited except the starting city $s$ and the destination city $t$ ).	(7+8)	CO4	L6
1	Edge weights are given as below: $A \rightarrow B = 4$ , $A \rightarrow C = 2$ , $B \rightarrow C = 5$ , $B \rightarrow D = 10$ , $C \rightarrow E = 3$ , $D \rightarrow F = 11$ , $E \rightarrow D = 4$ , $E \rightarrow F = 5$ Design the algorithm for the above problem and find the path from A to F that minimizes the combined cost of both travel and intermediate city expenses. Assume visitation cost of each vertex is 5. Ensure that the solution accounts for the weighted nature of both edges and nodes.			
Q.4	(a) Write the algorithm to clone the element of a source stack S to destination stack D maintaining the same order without using the extra space. Also show the step by step process for example $S = \{2, 5, 7, 9\}$ where 9 corresponds to top of the stack.	(5)	CO4	L3
	(b) Evaluate the following postfix expression using stack: 6 2 3 + $-$ 3 8 2 / + * 2 ↑ 3 +. Show intermediate steps.	(5)	CO1	L3

.5	(a) Given the code to implement double-e	nded qu	ieue (	deque	e) us	sing	circu	ılar	array	/ that	(12)	CO1	L2
	supports the following operations (i) isFull(	): Deque	is ful	ll (ii)	inse	rtFro	nt(in	it x):	Inse	ert an			
	element x at the front of deque (iii) isEmpty(	): Deque	is em	pty ar	nd (in	v) de	leteR	lear(	): Re	move			
	an element from the rear. Assume array in initialized to -1. You need not to write entire of	ndexing	starts	iron	1 0 7	and	front	and	i rea	ir are			
	to the fill in the blanks (1-10). What will be the	oue jusi	omple	ion th	e sta	atem	ents	corre	espo:	naing			
	const int MAX_SIZE = 100;	booli			) LIIE	ese 4	lunc	tions	6.				
	int deque[MAX_SIZE];		6	2 0 0	) (								
	int front = -1;	100	eturn t		_] {								
	int rear = -1;	1	eturn (	Tue,									
	bool isFull() {	roti	ırn fal	cor									
	if (1== front) {	1	II II Iai	se,									
	return true;	J											
	}	void d	leletel	Rear	{								
	return false;		isEmp										
	}	1	(			) (							
	void insertFront(int x) {	***	(	8		-J l							
	if (!isFull()) {	3		_0								1.1	1
	if (front == -1) {	ام ا	se {										
	2 ;	1	if (	9		) /	ī.						
	deque[front] = x;			r = MA							2		
	}		} else		IV_O	ILL	1,						
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	if (3) {		}		/								
	front = MAX_SIZE - 1;	3	1										
	} else {	1									1		
	4	1											
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	} 5;}}	J			)								
	(b) Consider the following sequence of integ	ers: 1, 2	2, 3, 4,	5, 6,	7, 8,	, 9. Y	'ou a	re re	quir	ed to	(12)	CO3	1.3
	111	ers: 1, 2	2, 3, 4, the ne	5, 6,	7, 8,	, 9. Y	ou a	re re	equir	ed to	(12)	CO3	L3
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