USN

R. V. COLLEGE OF ENGINEERING
Autonomous Institution affiliated to VTU
V Semester B. E. Examinations August 2022
Computer Science and Engineering
ADVANCED ALGORITHMS (Elective)

Time: 03 Hours   *Maximum Marks: 100*

Instructions to candidates:
1. Answer all questions from Part A. Part A questions should be answered in the first three pages of the answer book only.
2. Answer FIVE full questions from Part B.

PART A

1	1.1	If base n representation is used by radix sort algorithm on an array of n integers in the range of $[0...n^5-1]$, the complexity will be _____.	01
	1.2	Consider the strings "ABCDEABCD" and "ACPEAQCBCAD". What is the length of the longest common sub sequence?	01
	1.3	Bucket sort has best case time complexity of _____ if m is the number of buckets.	01
	1.4	In a network flow graph G=(V,E), the flow from one vertex to another must be positive an not more than given capacity, this is termed as _____.	01
	1.5	In a Ford-Fulkerson method if the capacity function takes only integral values, then the maximum flow produced has _____ property.	01
	1.6	Fibonacci heap is simply a gathering of _____ binomial trees.	01
	1.7	Identify which operation is inefficient for both binary heaps and Fibonacci heaps.	01
	1.8	What is the advantage of counting sort over heap sort?	01
	1.9	The set of all real numbers under the usual multiplication operation is not a group because _____.	01
	1.10	The time complexity of finding all the possible ways of multiplying a set of n matrices is given as _____.	01
	1.11	The two activities i and j are said to be non conflicting activities if they satisfy time of activities **i** and **j** respectively, and fi and fj refer to the finishing time of the activities **i** and **j** respectively.	02
	1.12	GCD of given two numbers GCD(210,45) using Euclidian algorithm is _____.	02
	1.13	What is the value of expr-2 in the given recursive definition to find length of the longest common sub-sequence (LCS) of $X[m]$ and $Y[n]$ as $l(m,n)$. $l(i,j) = 0, if\ either\ i = 0\ or\ j = 0$ $= expr1, if\ i,j > 0\ and\ X[i-1] = Y[j-1]$ $= expr2, if\ i,j > 0\ and\ X[i-1] \neq Y[j-1]$	02
	1.14	For the given set of activities the start time is given by array S and finish time is given by array F, select the largest number of compatible activities from the following data $A = \{A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11\}$ $S = \{1,3,0,5,3,5,6,8,8,2,12\}$ $F = \{4,5,6,7,9,9,10,11,12,14,16\}$	02

1.15	In the following code, fill in the given blank with appropriate option in line 2.	02
	$RECURSIVE - ACTIVITY - SEELECTOR(s, f, i, j)$	
	1 $m \leftarrow i + 1$	
	2 $\textbf{while } m < j \text{ and } \underline{\hspace{2cm}}$	
	3 $\quad \textbf{do } m \leftarrow m + 1$	
	4 $\textbf{if } m < j$	
	5 $\quad \textbf{then return } \{a_m\} \cup RECURSIVE - ACTIVITY - SELECTOR(s, f, m, j)$	
	6 $\quad \textbf{else return } \emptyset$	

PART B

2	a	Apply substitution method to prove an appropriate tight asymptotic upper bound recurrence $T(n) = 2T\left(\frac{n}{2}\right) + 1$	08
	b	Solve the following recurrence relation using tree method - $T(n) = 2T\left(\frac{n}{2}\right) + n$	08

OR

3	a	Write an algorithm to perform Counting sort and discuss its efficiency. Prove that the lower bound of any comparison based sorting algorithm is $\Omega(n\log n)$.	08
	b	Consider the input strings "ABCBDAB" and "BDCABA". Apply LCS algorithm to determine the longest common subsequence using dynamic programming technique.	08

OR

4	a	Perform radix sort on the following input. Write the algorithm and discuss its time complexity. **56 766 32 12 242 564 76 890 10 22**	08
	b	For the following graph below apply Ford-Fulkerson algorithm and find the augmented path and the maximum network flow. Draw the residual graph for each path and record all the calculations and steps. Figure 4b	08

5	a	Assume that we are funning Ford-Fulkerson algorithm and in network below has a flow of 3. Perform the following:
		    1. Draw the residual graph
		    2. Give an augmented path
		    3. Draw the new flow network based on your augmenting path
		    4. Draw the new residual graph.
		Record all the calculations and steps.
			10

Figure 5a

	b	Identify in which algorithm the pre processing step involves topological sorting to find single source shortest path. With a pseudo code explain the algorithm and time complexity.	06

OR

6	a	For the bipatitte graph shown below, find the maximum flow using Ford-Fulkerson algorithm, Identify the flow, capacity, residual capacity, the augmented path and record all the calculations and steps involved.	

Figure 6a

			10
	b	Examine and identify the time complexity of Johnson's algorithm to find All pairs Shortest path. Write the pseudo code.	06

7	a	Solve the following using Chinese remainder theorem. $a \equiv 4 \ (mod \ 12)$ $a \equiv 4 \ (mod \ 5)$ $a \equiv 4 \ (mod \ 6)$	
			08
	b	Solve the modular exponentiation using raising to powers with repeated squaring $73^{275} \ mod \ 1172$	08

8	a	The two heap diagrams has pointers to its min values apply union on these heaps
		    1. Perform Union on these heaps and identify the min on the resultant heap
		    2. For the resultant heap after performing (1) above extract the minimum node and find the next min.	

			08

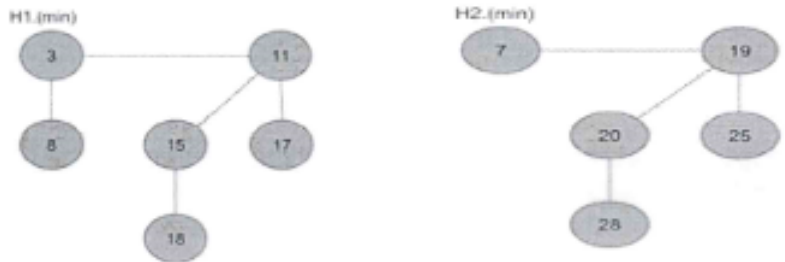Write the complete process with diagram and also explain the procedure to do so.

Figure 8a

b   Write the pseudocode of Finite Automata based String matching algorithm and apply the same for the following input
Text : XYXYX
Pattern: XXYXXYYYXYXYXXYXYX

08