

Time: 90 mins.

Maximum Marks: 50

Note:

- (i) Answer all the questions by choosing any one of the sub questions.
- (ii) Each question carries 10 marks
- (iii) Write to the point answer.

Q1	(10 marks)	
(a)	<p>a) Solve the following recurrence relation using substitution. (5 marks)</p> $T(n) = T\left(\frac{n}{2}\right) + cn, \text{ if } n > 1$ $T(n) = 1, \text{ otherwise}$ <p>b) What will be the time complexity of the following piece of pseudo code. (5 marks)</p> <pre> i ← 1 a is array while(i < √n) { for j ← 0 to n-1 { a[j] ← i } i ← i*2 } </pre>	CO1 & CO2
OR		
(b)	<p>a) Draw and show how merge sort will work on the following array of numbers. (5 marks)</p> <p>36, 2, 9, 20, 17.</p> <p>b) Write the pseudo-code to multiply two numbers a and b on a machine where we have only '+' and no '*'. i.e we cannot multiply the numbers directly. Try to do it in minimum time complexity possible. (5 marks)</p>	
Q2	(10 marks)	
(a)	<p>a. Arrange the following in ascending order of time complexity:-</p> $n^2, \log_2(n), 2^n, 1.0001^n, n * \log_2(n)$ (5 marks) <p>b. Prove mathematically after writing the pseudo-code that complexity of merge sort is $O(n * \log_2(n))$. (5 marks)</p>	
OR		

(b)	<p>i) Solve the following recurrence:- (6 marks)</p> $T(n) = 2T\left(\frac{n}{4}\right) + \log(n), \text{ if } n > 1$ $T(n) = 1, \text{ otherwise}$ <p>ii) Fill in the blank</p> <p>Worst case time complexity of quick sort in which we choose last element as pivot is _____ and it occurs when all the elements of the array are arranged in _____ order (4 Marks)</p>	CO1
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Q3

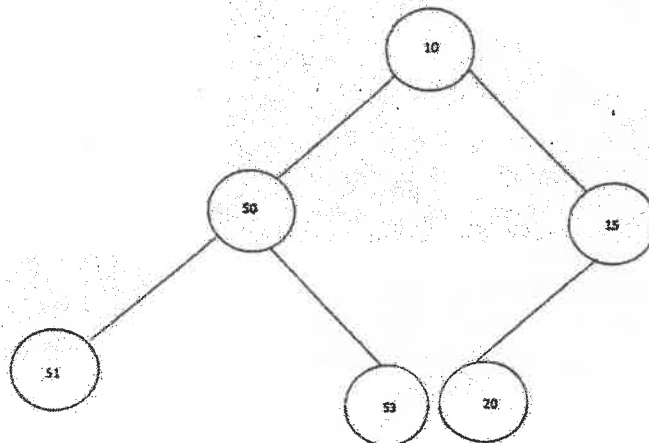
(10 marks)

CO2
&
CO3

- Consider a binary min heap to answer the following
- Time complexity to convert an array of n elements to binary min heap (2 mark)
 - Time complexity to insert a new element in binary min heap having n elements (2 Mark)
 - Time complexity to delete the minimum element. (2 Mark)
 - Time complexity to convert min heap to max heap (2 Mark)
 - Binary min heap is stored as array. [True/False] (2 Mark)

OR

- (b) Insert the following numbers in the given binary min heap one by one in the given order.
Numbers 17, 21, 39, 54, 20
Show each insertion clearly. Circle your final heap.



Q4

(10 marks)

- Write the code for quick sort and show how the worst case time complexity is $O(n^2)$. (4 marks)
 - Compare between quick and merge sort. (6 marks)

CO1

OR

- What do you understand by in-place sorting, stable sorting and online sorting. Explain with proper example of at least one algorithm in each of the above mentioned sorting type. (6 marks)
 - Write the code for insertion sort and find the time complexity in Best, Average and worst Case (4 marks)

Q5

(10 marks)

- Solve the following Recurrence relation. (5 marks each)
 - $T(n) = 2T(n-1) + n$
 $T(1) = 1$
 - $T(n) = T(\sqrt{n}) + 1$
 $T(1) = 1$

CO1

OR

- Write the code to solve Tower of Hanoi and find its complexity using recurrence relation. (5 marks)
 - Write the code to solve fibonacci series using recursion and find its complexity. (5 marks)