NAME :..... .....

National Institute of Technology Calicut
Department of Computer Science and Engineering
PhD Admission Written Test- Part I

Time: 1 Hour
Max. Marks : 20

1. Which of the following statements is **not** correct? 1 Mark

a) Quicksort is a stable sorting algorithm.
b) Mergesort takes θ(nlogn) running time in the average case.
c) Insertion sort runs in $\theta(n^2)$ time in the worst case.
d) Heap sort runs in θ(nlogn) time in the worst case.

2. The contents of a hash table of size 11 with open addressing and quadratic probing with the hash function $(k \bmod 10 + 3i + i^2) \bmod 11$, after inserting 6 elements into the table is as shown below.
To which of the slot will the next key with value 14 will be hashed into? 1 Mark

			3	15	5		23	18	9		
		0	1	2	3	4	5	6	7	8	9	10

i) 0 ii) 1 iii) 2 iv) 6 v) 10

3. Which of the following statements regarding Priority Queue is/are incorrect? 1 Mark

i) The maximum value in a min- heap with distinct values will be amongst the leaf nodes.
ii) The maximum Value in a max-heap will be the root.
iii) HEAP-INCREASE-KEY operation of a max-heap is O(lg n).
iv) HEAP-MAXIMUM operation of a max-heap is O(lg n)
v)The running time of Heap-EXTRACT-MAX of a max-heap is O(1).

4. Which of the following arrays is not a Max-heap? 1 Mark

a) 12 8 6 3 4 1 **b)** 21 20 19 18 17 16 **c)** 15 11 13 10 9 12
d) 56 50 42 48 46 44

5. Which of the following is the post-order travel of a Binary Search Tree whose preorder traversal is 30 24 16 8 27 28 36 40 38.

a) 28 27 16 8 24 38 40 36 30 b) 8 16 28 27 24 38 40 36 30 c) 38 40 36 28 27 16 8 24 30
d) 16 8 27 24 28 40 38 36 30

6. Let T be a BFS tree of a graph G=(V,E), with root r. Let d(u,v) denote the length of the shortest path between the nodes u and v. If v is visited before u in the breadth-first search traversal of T, which of the following statements is true? 1 Mark

a) d(r,v) = d(r,u) b) d(r,v) < d(r,u) c) d(r,v) > d(r,u) d) d(r,v) <= d(r,u) e) d(r,v) >= d(r,u)

7. The algorithm for insertion and deletion of nodes to a doubly linked list is as shown below. The data structure given below will work as : 1 Mark

List-Insert(L,x)	List –Delete(L)
1. x.next= L.head	1. x= L.head
2. If L.head ≠ NIL	2. x.next.prev = NIL
3. L.head.prev =x	3 L.Head = x.next
4. L.head =x	4 return (x.data)
5. x.prev = NIL	

a) Queue b) Stack c) Priority Queue d) None of these.

8. Consider a a graph G=(V,E) with |V|=n and k components. If a vertex v∈V is removed from the graph the number of components in the resultant graph will be
a) k-1 b) k+1 c) between k and n d) between k-1 and n-1 e) between k+1 and n-k f)between k-1 and k+1 1 Mark

9. Write the recurrence relation for the running time of the following recursive function. 2 Marks

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Sum(a,i,n)
1. if (i<n)
2.     return(a[i]+Sum(a,i+1,n))
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10. What would be the minimum and maximum number of elements in a heap of height h? 2 Marks

11. Is $3^n = O(2^n)$ (Yes/No)? Justify your answer. (Write the answer on the other side of this sheet) .
2 Marks

12. Solve the following recurrence relation . 2 Marks

$T(n) = 4T(n/4) + \theta(1)$

13.What is the probability that an *n* node BST with unique keys constructed using only BST insertion operations have a height exactly equal to *n-1* (Assume that every input sequence is equally likely)? Prove your answer. 2.5 Marks

14. Write an O(n) algorithm that takes as input a pointer to a singly linked list containing integer data and return the number of nodes having data that is a multiple of 5. 2.5 Marks
(Write the answer on the other side of this sheet)