COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra)

END Semester Examination

Programme: T.Y. B.Tech
Course Code: CT(DE)-17038/IT(DE)-17036
Branch: Computer Engineering/Information Technology
Duration: 3 hours

Semester: VI
Course Name: Advanced Data Structures
Academic Year: 2017-18
Max Marks: 60
PRN No:

Instructions:

1. This is open notebook exam. You are allowed to use your own handwritten notebook.
2. Mobile phone, programmable calculator, laptop, book(s), photocopied material are strictly prohibited.
3. Exchange/sharing of notebook(s), stationery, calculator etc. not allowed.
4. Figures to the right indicate full marks.
5. Write your PRN Number on your Question Paper.
6. Writing anything, except PRN No, on question paper is not allowed.

			Marks	CO	PO
Q1	a	Suppose we are doing a sequence of operations (numbered 1, 2, 3,...) such that the i^{th} operation: - costs 1 if i is *not* a power of 2, and - costs i if i *is* a power of 2. Find the amortized cost of n operations using aggregate method.	4	CO-2	PO-1 PO-9
	b	Consider an nXn array of integers. We have to find the minimum element in every column. The array is stored in row-major form. There are 2 cache lines available where each cache line can hold n integers. For example, given the following array with n = 4, the expected answer is - 1:3, 2:1, 3:3, 4:1.	4	CO-1 CO-2	PO-1 PO-4 PO-9

4	2	7	3
3	6	3	2
5	1	4	2
6	8	4	1

Write pseudo code that will minimize the cache-misses. What is the expected number of cache misses in your program?

			Marks	CO	PO
	c	There are 8 runs, 7 containing 200 records and 1 containing 100 records of equal size, on the disk. A block in memory can hold 50 records. The runs are to be merged using an optimal 4-way merge strategy. Assume that each merge is done using a loser tree. Answer the following: i) How many dummy runs will have to be added for optimal 4-way merge? ii) Determine the number of comparisons and the number of disk I/Os for the entire merging.	4	CO-1 CO-2 CO-3	PO-1 PO-4 PO-7 PO-9
Q2	a	Encode the string "College of Engineering Pune" using (i) Fixed length code and (ii) Variable length code using Huffman tree (treat 'E' and 'e' as different characters). Compare the size of encoded string in each case with the actual string size assuming one byte is required to represent one ASCII character.	4	CO-1 CO-2 CO-3	PO-1 PO-4 PO-7 PO-9
	b	Consider the Total Correspondence structure shown below (Fig–1).	4	CO-1	PO-4

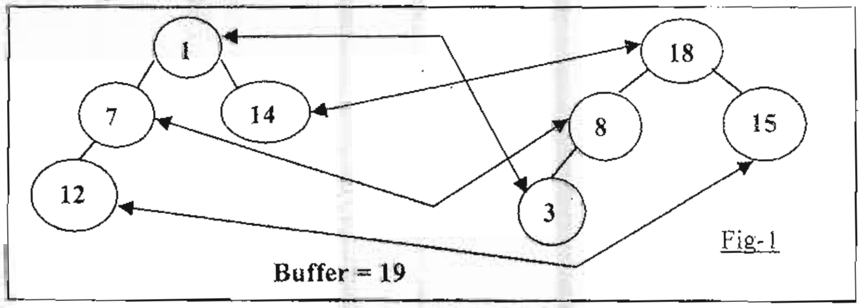

Fig-1

Show how the structure would change if RemoveMin operation is performed on it.

		Marks	CO	PO

Q2 c Assume following node structure for representing a height balanced binary tree: — Marks: 4, CO: CO-3, PO: PO-4, PO-7

LCHILD	DATA	HEIGHT	RCHILD

Height of empty tree is 0 and is equal to number of internal nodes on the longest path from root to some external node in the tree. Write pseudo code for calculating height of the tree pointed to by PTR. That is,
Input: Pointer PTR to the tree whose height is to be calculated and **Output:** Height of the tree.

Q3 a Consider the Fibonacci heap shown below (Fig-2): — Marks: 4, CO: CO-1, CO-3, PO: PO-4, PO-9

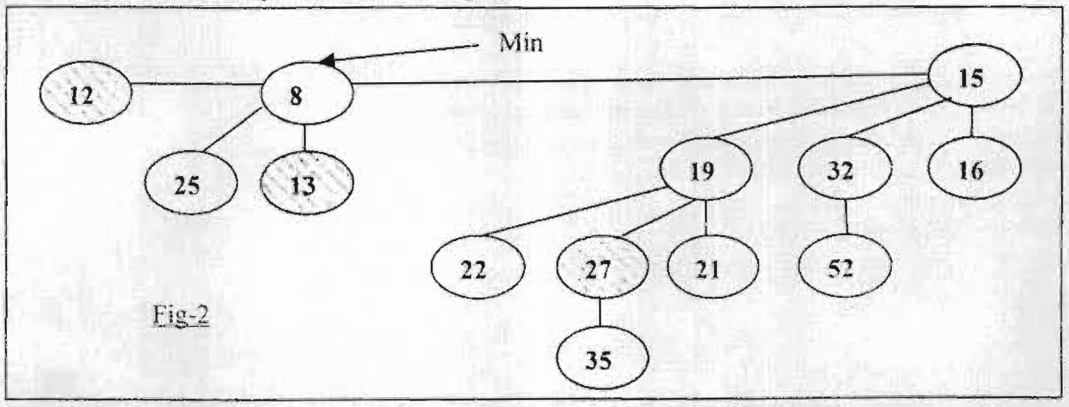

Fig-2

The nodes that have lost first child are shown with dark background. Show how the heap would change, in step-by-step manner, if following two 'DecreaseKey' operations are carried out one after the other:
(i) Decrease 21 by 18 (i.e. make it 3) (ii) Decrease 35 by 21 (i.e. make it 14)

b Find optimal binary search tree for a set of 5 keys with the following frequencies: — Marks: 4, CO: CO-1, CO-2, CO-3, PO: PO-1, PO-4, PO-7, PO-9

i	0	1	2	3	4
pi	--	15	10	20	30
qi	10	5	5	0	5

c Consider a 3-order B-tree as shown below (Fig-3): — Marks: 4, CO: CO-1, CO-3, PO: PO-1, PO-4, PO-7, PO-9, PO-11

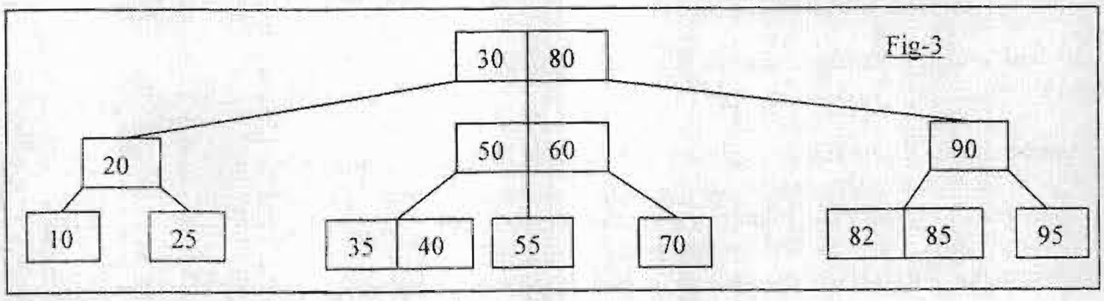

Fig-3

Show how the tree would change if 44 is inserted into the tree.

Q4 a Draw the min leftist tree that results after melding the following two min leftist trees (Fig-4): — Marks: 6, CO: CO-1, PO: PO-9

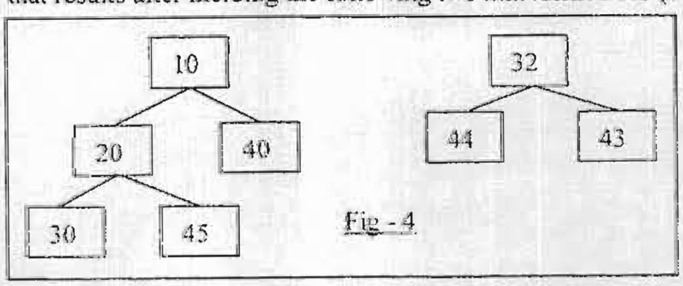

Fig - 4

b Into an empty min pairing heap, insert elements with priorities 20, 10, 5, 18, 6, 12, 14, 9, 8 and 22. From the resultant pairing heap, delete the minimum element using two-pass algorithm. — Marks: 6, CO: CO-1, PO: PO-9

Q5 a Show the AVL search trees that result after successively inserting the following values into an initially empty AVL tree: 15, 20, 24, 10, 13, 7, 30, 36, 25 — Marks: 6, CO: CO-1, PO: PO-7, PO-9

b Show the red-black trees that result after successively inserting the keys into an initially empty red-black tree: 2, 1, 4, 5, 9, 3, 6, 7 — Marks: 6, CO: CO-1, PO: PO-7, PO-9

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