# COP 5536

# Advanced Data Structures
# Spring 2021

## Exam 2
## CLOSED BOOK
## 9:00 am – 10:30 am
**(60 Minutes + Extra 30 Minutes for scanning & submission)**

**PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY**

**1.** For all problems, use only the algorithms discussed in class/text.
**2.** Write your answers directly on your own white blank paper. You may use extra scratch paper for calculation, but these will not be submitted.
**3.** All answers will be graded on correctness, efficiency, clarity, elegance and other normal criteria that determine quality.
**4.** You may use only a pen or a pencil. No calculators allowed.

**Note. All answers will be graded on correctness, efficiency, clarity, elegance and other normal criteria that determine quality. The points assigned to each question are provided in parentheses.**

Last Name: _____

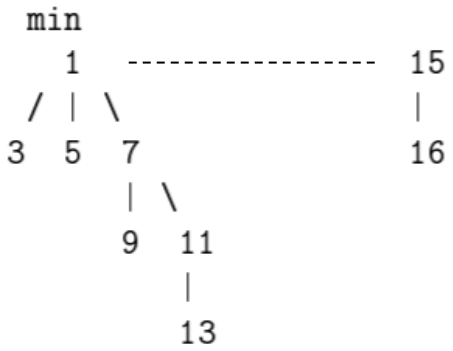
First Name: _____

UFID: _____

| Q. 1 (10) | Q. 2 (12) | Q. 3 (14) | Q. 4 (14) | Total (50) |
|---|---|---|---|---|
| | | | | |

## Question 1 (10):

For the following min Fibonacci heap, assume that the *ChildCut* field of all nodes is TRUE.

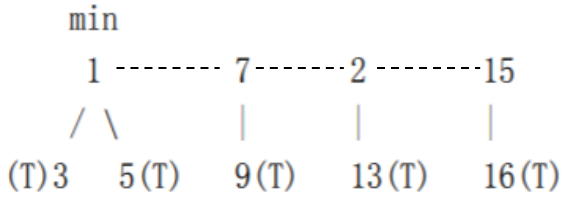



(a) (4) Perform *DecreaseKey* operation by changing 11 to 2. Show the result.

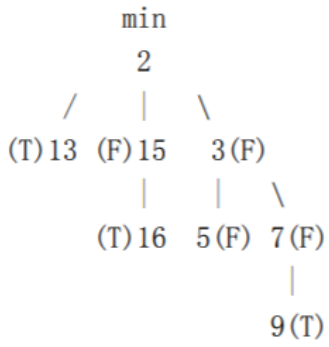
(b) (6) Perform *DeleteMin* operation on the resulting Fibonacci heap from (a), clearly label the *ChildCut* value. Show the result.

**Solution**:

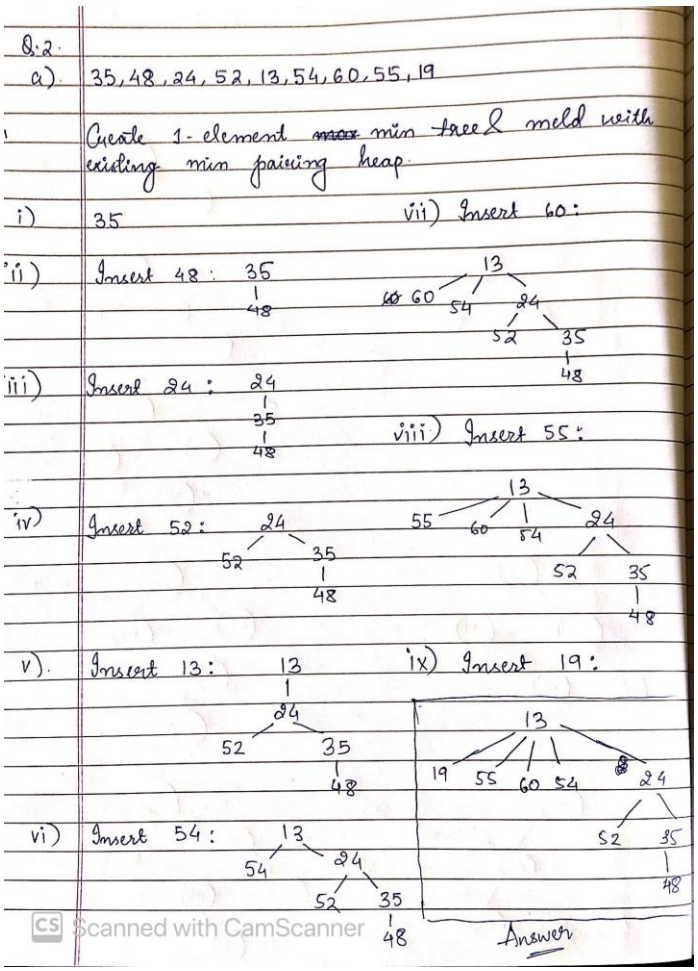
(a) Correct results(2pts), draw *ChildCut* and links (2pts)



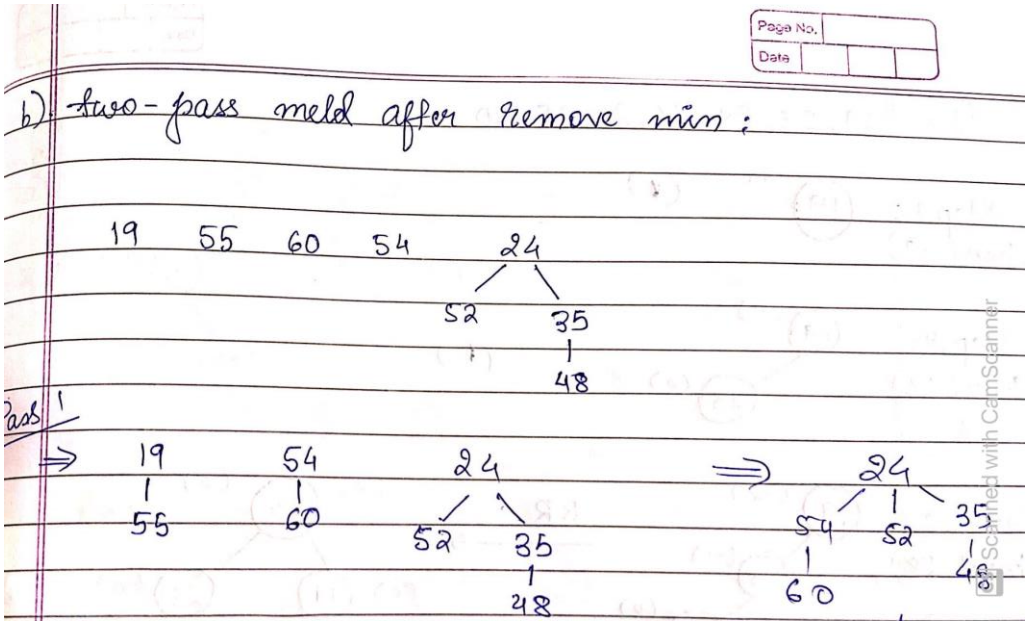

(b) Correct results(4pts), *ChildCut* value(2pts)

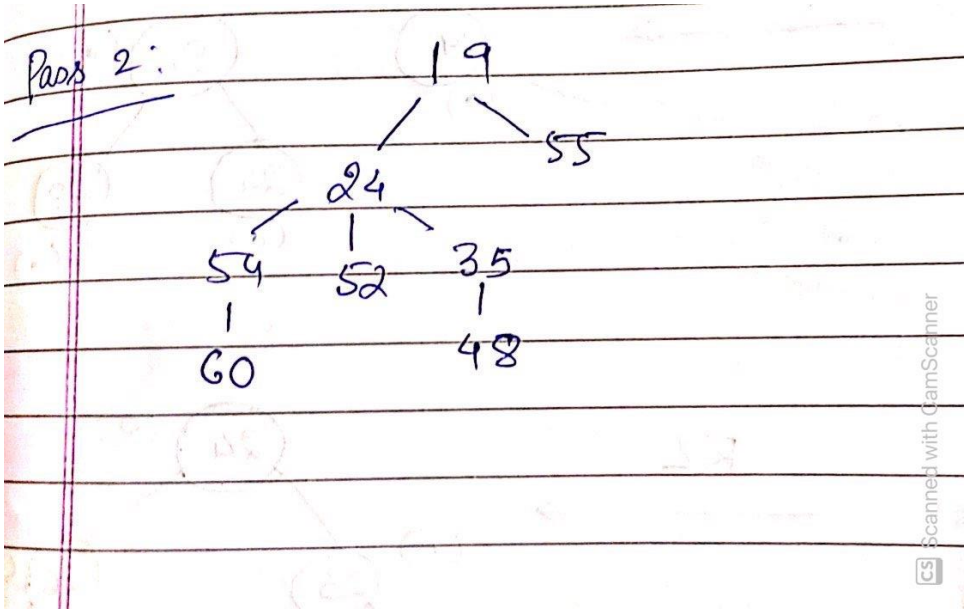


Question 2 (12):
Start with an empty two-pass **MIN** pairing heap,
(a). (6) Insert the following sequence of keys: 35, 48, 24, 52, 13, 54, 60, 55, 19. Show the pairing heap after each insert.
(b). (6) Perform a RemoveMin operation on the resultant min heap from (a). Show steps.

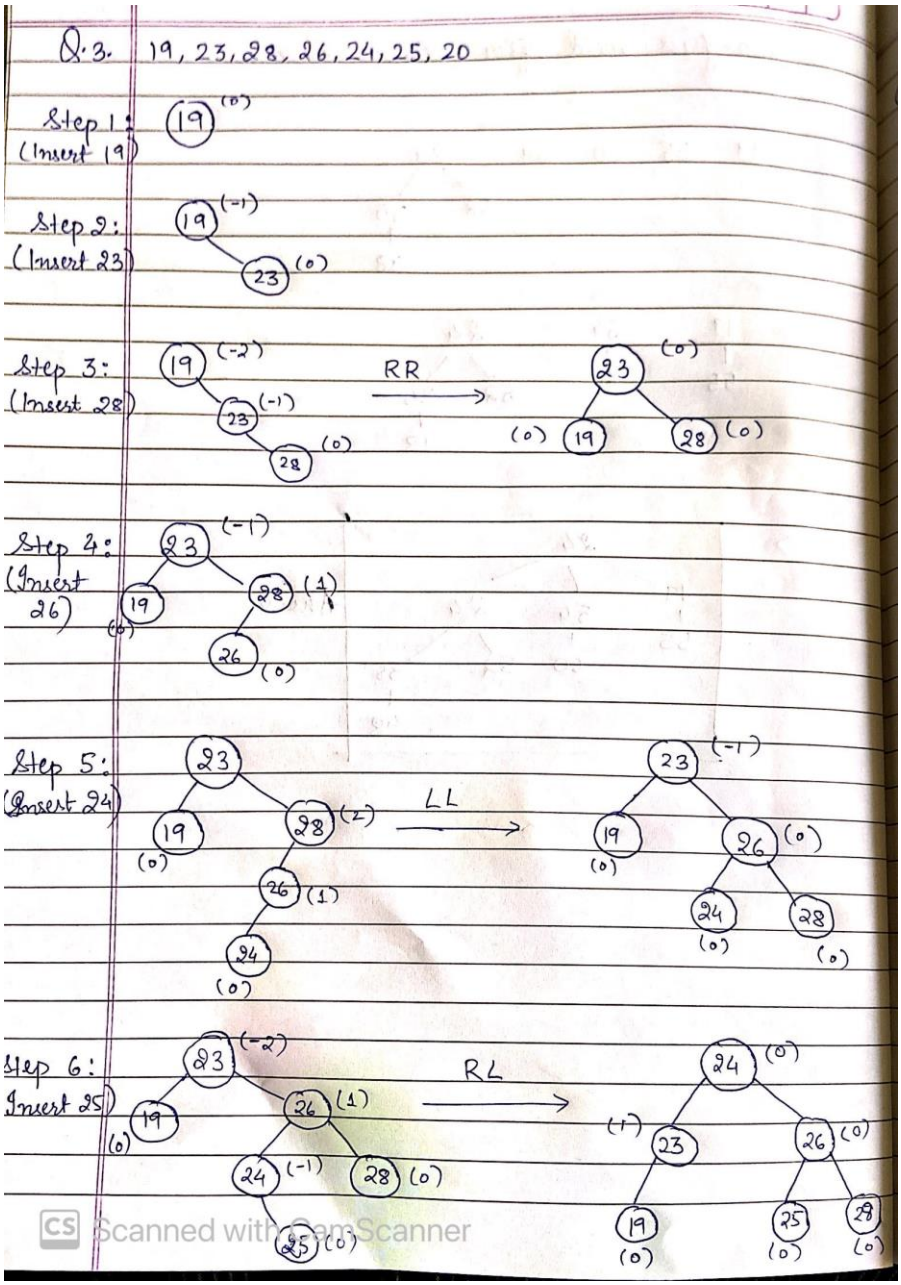


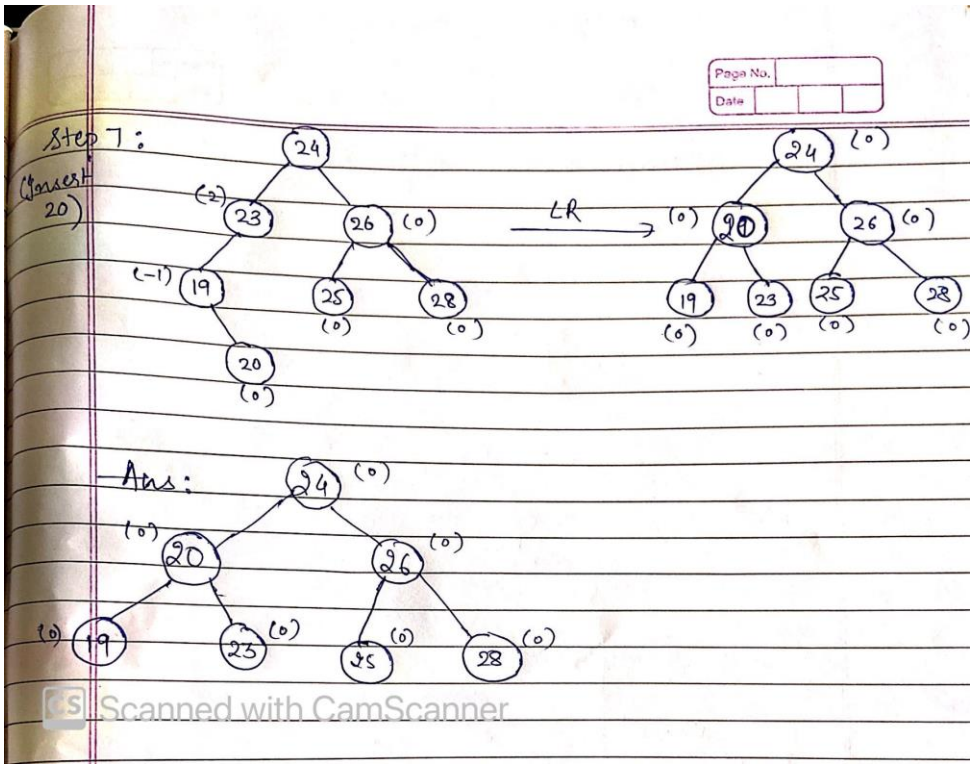
b) ~~two~~-pass meld after remove min:



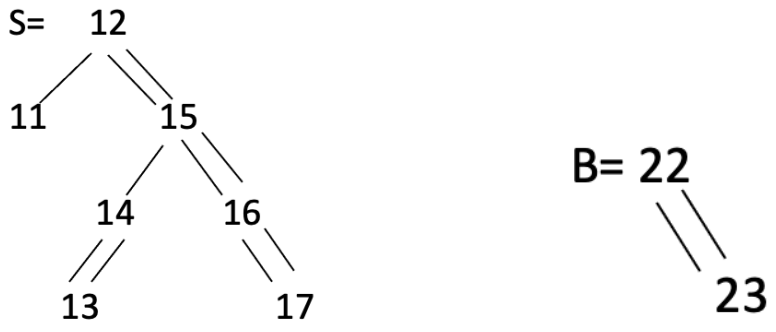



Question 3 (14):
Start with an empty AVL tree and perform insert operations using the following sequence of keys: 19, 23, 28, 26, 24, 25, and 20.
**Show each step and degree at each step.**

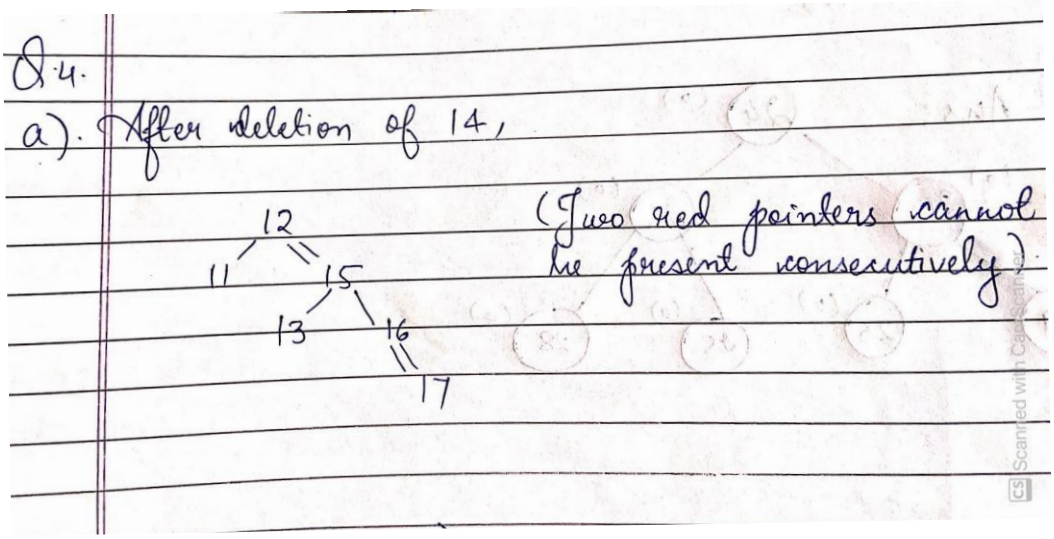





Question 4 (14):
For the following red-black trees (double links are red links),



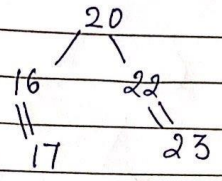
(a). (7) Consider the red-black tree above. Perform delete (14) operation for red-black tree S, showing each step.
(b). (7) Perform Join (S; 20; B) on the **ORIGINAL** red-black trees in the above figure, showing each step



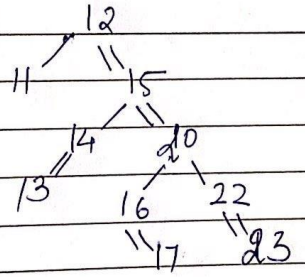
b) Join (8, 20, B)

Step 1: Follow the right child pointer until, rank(B) = x
where rank(B) = 1
x = node pointer for tree 8.

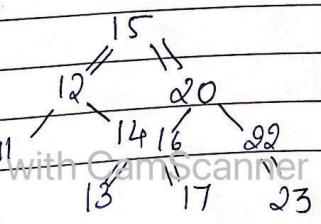
Step 2: Combine x, 20, B




Step 3: Combine the result of step 2 to node 15 through via red pointer.




Step 4: Since there is two consecutive red nodes, perform an RR rotation.




Ans