

Consider a disk with a sector size of 512 bytes, 2000 tracks per surface, 25 sectors per track, five double-sided platters, and average seek time of 5 msec. Suppose that a block size of 2048 bytes is chosen. Suppose that a file containing 100, 000 records of 200 bytes each is to be stored on such a disk and that no record is allowed to span two blocks.

1. **What is the capacity of a track in bytes? What is the capacity of each surface? What is the capacity of the disk?**

Capacity of a track in bytes:

$$\begin{aligned}\text{bytes/track} &= \text{bytes/sector} * \text{sectors/track} \\ &= 512 * 25 \\ &= \mathbf{12,800 \text{ bytes}}\end{aligned}$$

Capacity of each surface:

$$\begin{aligned}\text{bytes/surface} &= \text{bytes/track} * \text{tracks/surface} \\ &= 12,800 * 2000 \\ &= \mathbf{25,600,000 \text{ bytes}}\end{aligned}$$

Capacity of the disk:

$$\begin{aligned}\text{bytes/disk} &= \text{bytes/surface} * \text{no. of surfaces} \\ &= 25,600,000 * 5 * 2 \\ &= \mathbf{250,600,000 \text{ bytes}}\end{aligned}$$

2. **How many records fit onto a block?**

Block size/no. of records = $2048/200 = 10.24 \rightarrow$ Thus, at most 10 records can fit in a block.

3. **How many blocks are required to store the entire file?**

$$\begin{aligned}\text{No. of blocks required} &= \text{Total file size/Block size} \\ &= 100,000 * 200 / 2048 \\ &= 20,000,000 / 2048 \\ &= 9765.625 \text{ blocks}\end{aligned}$$

Approximately, 10,000 blocks are required to store the entire file.

4. If the file is arranged sequentially on the disk, how many surfaces are needed?

- No. of sectors/Track = 25
- Blocks/Sector = $2048/512 = 4$
- No. of Blocks/Track = $25 / 4$ blocks
- Thus, for each cylinder = $25/4 * 5 * 2 = 125 / 2$ blocks
- We need 10,000 blocks to store this file
- Total no. of cylinders = $10,000 / (125 / 2) = 160$ cylinders
- Since we need 160 cylinders, during sequential arrangement each track will be accessed on every surface one after the other. Thus, we need all the **10 surfaces** to store the file.

5. How many records of 100 bytes each can be stored using this disk?

- Capacity of the disk = 250,600,000 bytes
- Max number of records = 10
- Thus, the disk can store, maximum = $250,600,000/100 = 2,506,000$ records

6. If pages are stored sequentially on disk, with page 1 on block 1 of track 1, what page is stored on block 1 of track 1 on the next disk surface?

- Capacity of track = 12800 bytes
- Block size = 2048 bytes
- So, 1st track of disk 1 can store = $12800/2048 = 6.25$ blocks
- Thus, the block 1 of track 1 on the next disk surface will continue with 6th block followed by 7th block.

9.1.2.1

Case(1): Six Pointers $\Rightarrow n = 5$

Insert 7:

7

Insert 3:

3	7
---	---

Insert 5:

3	5	7
---	---	---

Insert 11:

3	5	7	11
---	---	---	----

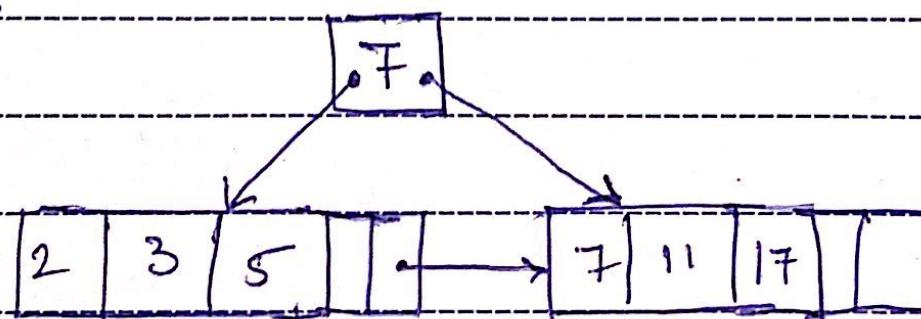
Insert 2:

2	3	5	7	11
---	---	---	---	----

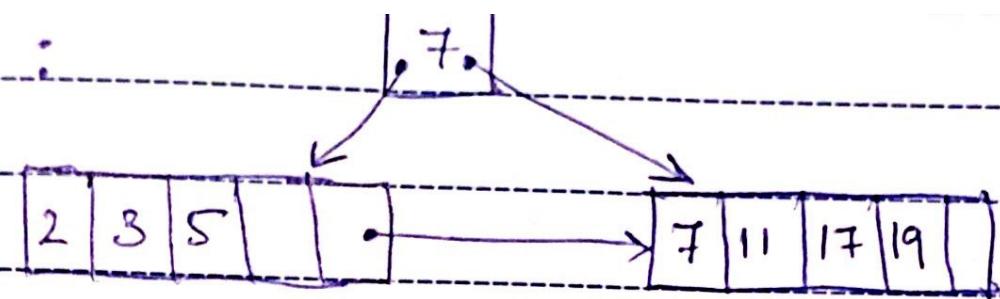
Insert 17:

2	3	5	7	11	17
---	---	---	---	----	----

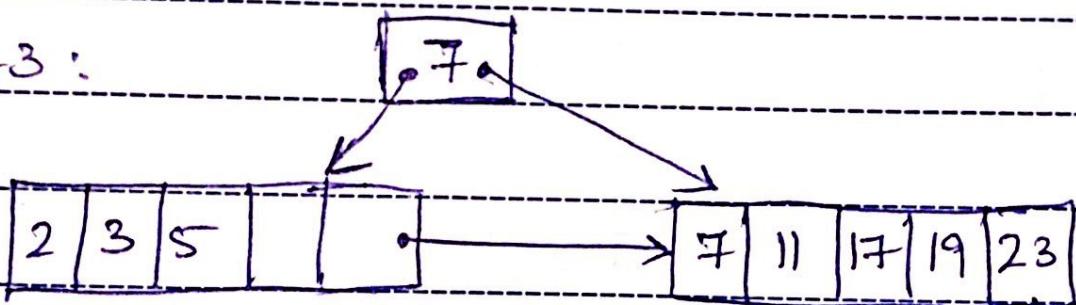
Splitting:



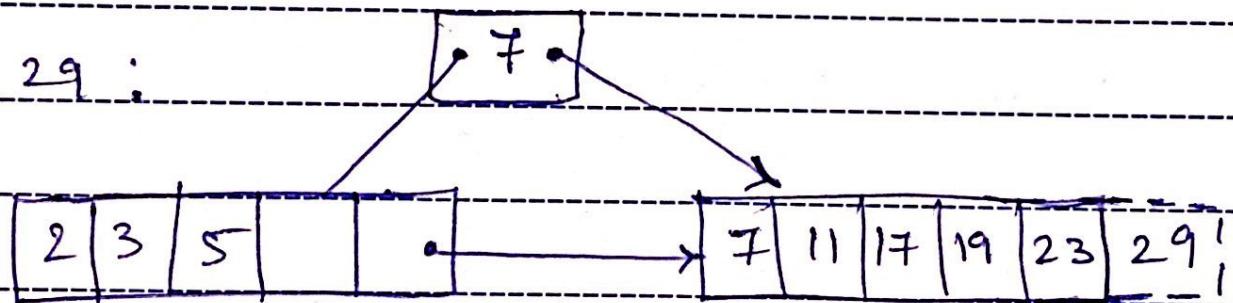
Insert 19 :



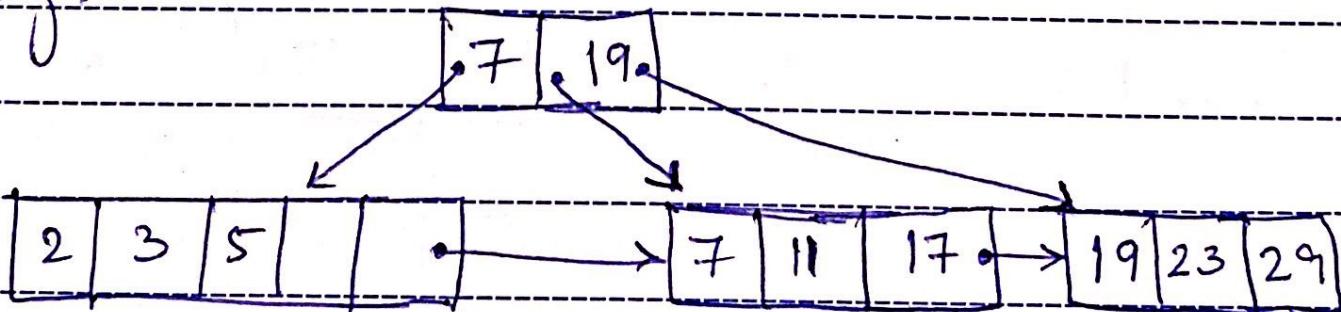
Insert 23 :



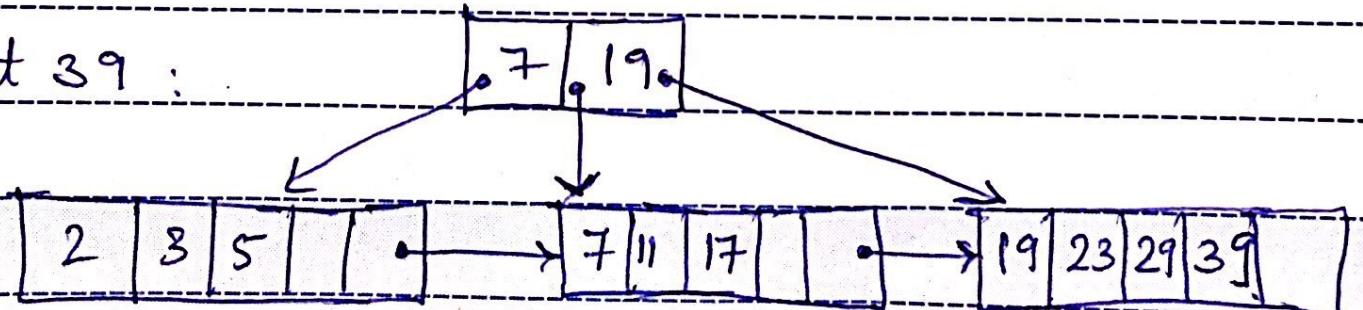
Insert 29 :



Splitting:



Insert 39 :



Case (2): Eight pointers $\Rightarrow n=7$

Insert 7:

7

Insert 3:

3	7
---	---

Insert 5:

3	5	7
---	---	---

Insert 11:

3	5	7	11
---	---	---	----

Insert 2:

2	3	5	7	11
---	---	---	---	----

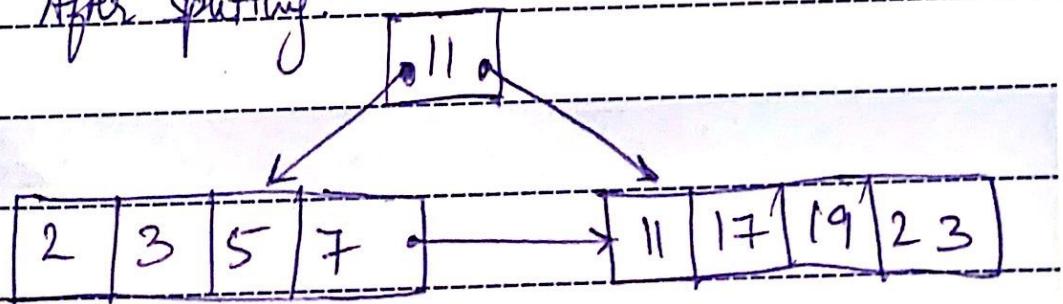
Insert 17:

2	3	5	7	11	17
---	---	---	---	----	----

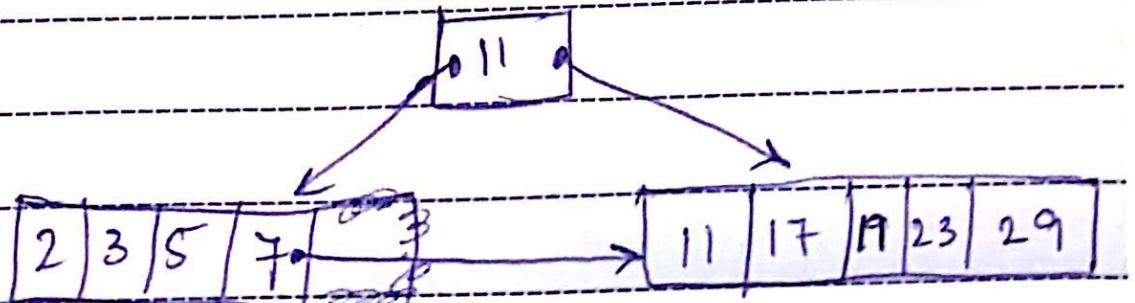
Insert 19:

2	3	5	7	11	17	19
---	---	---	---	----	----	----

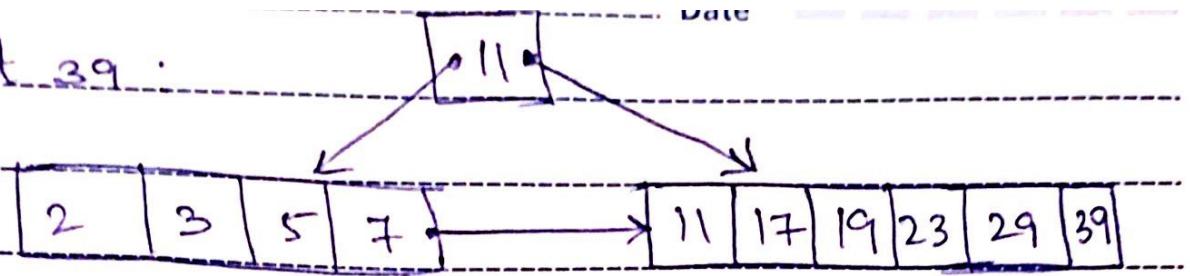
Insert 23: After Splitting:



Insert 29:



Insert 39 :

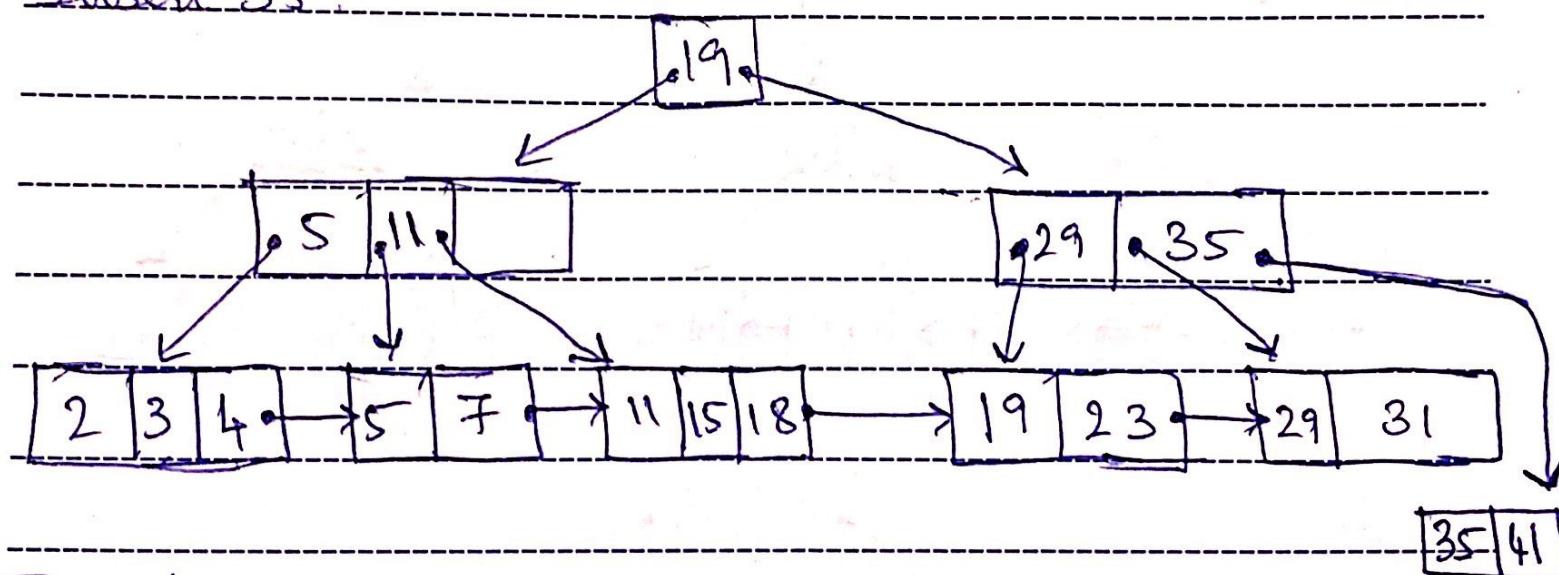


Q 1.2.2

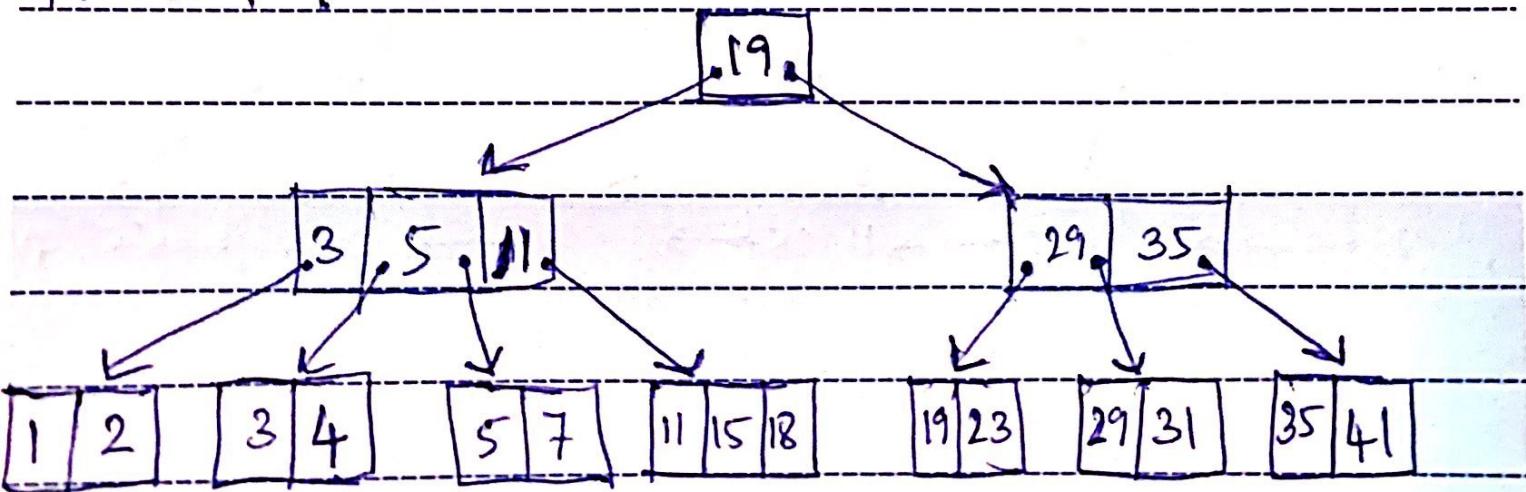
$$\text{Here } n = 3 \Rightarrow \text{Minimum keys leaf} = \left\lceil \frac{h+1}{2} \right\rceil = \frac{3+1}{2} = 2$$

$$\text{" " Non-key} = \left\lceil \frac{n+1}{2} \right\rceil - 1 = 1$$

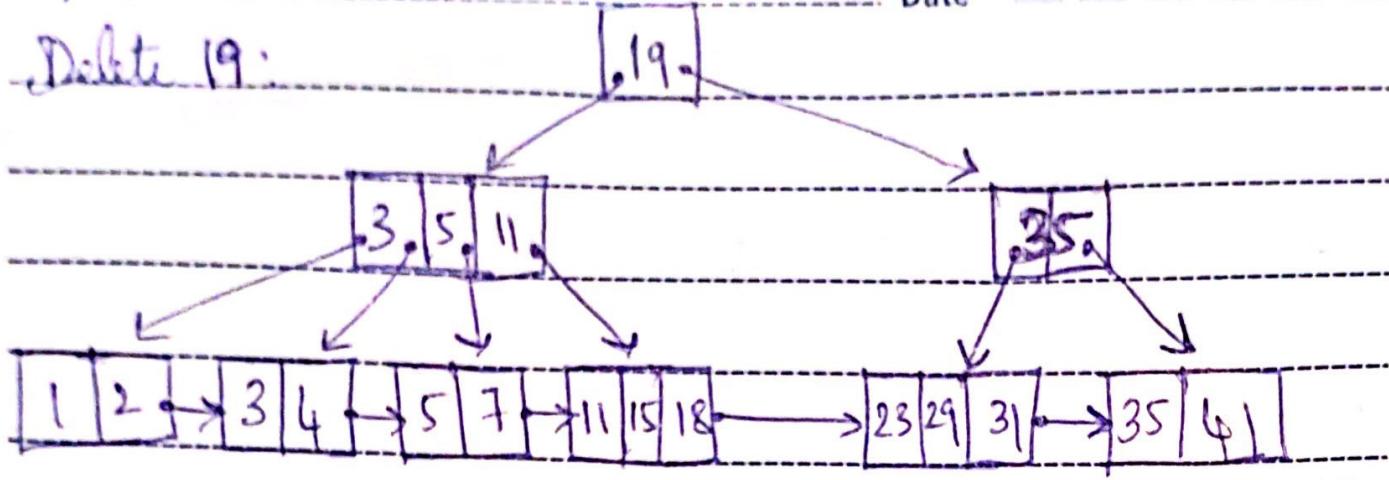
Insert 35 :



Insert 1 :



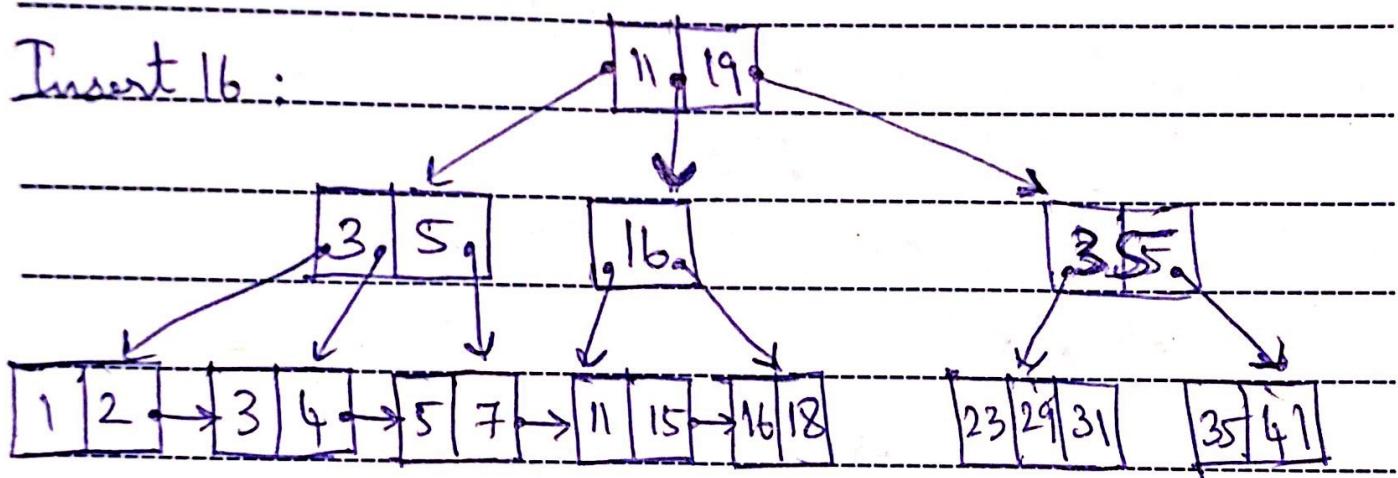
Delete 19:



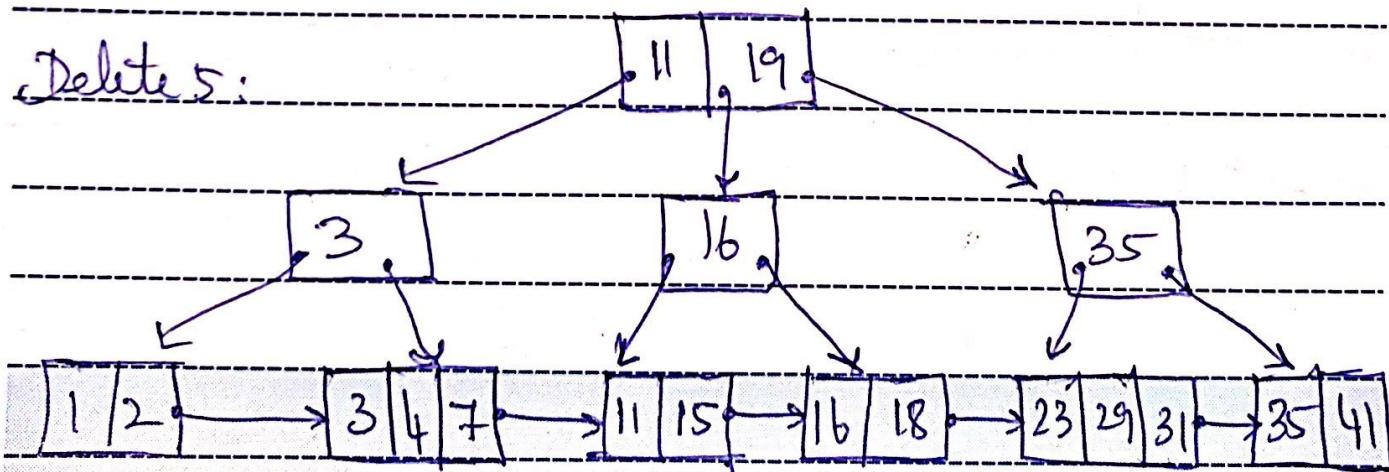
→ 23 key is merged due to underflow.

→ 29 key is removed due to less # of pointers.

Insert 16:



Delete 5:



→ 7 is merged due to underflow.

→ Key 5 is removed due to less # of pointers

