Q.1.

→ 1. Need matrix:-

	A	B	C	D
P0	2	1	0	3
P1	1	0	0	1
P2	0	2	0	0
P3	4	1	0	2
P4	2	1	1	3

2. P_2 — Need = 0 2 0 0

     Available = 0 3 0 1.

   ∴ P_2 is completed

P_1 — Need = 1 0 0 1

     Available = 3 4 2 2

   ∴ P_1 is completed

P_3 — Need = 4 1 0 2

     Available = 5 6 3 2

   ∴ P_3 completed

P_0 and P_4 cannot be completed

∴ The system is not in safe state.

Q. 2.

→ 1. Need matrix :-

	A	B	C	D
P0	0	0	0	0
P1	0	7	5	0
P2	1	0	0	2
P3	0	0	2	0
P4	0	6	4	2

2. P0 : Need = 0000
    Available = 1520   ∴ P0 completed
    P2 : Need = 1002
    Available = 1532   ∴ P2 completed
    P3 : Need = 0020
    Available = 2886   ∴ P3 completed
    P4 : Need = 0642
    Available = 2 14 11 8   ∴ P4 completed
    P1 : Need = 0750
    Available = 2 14 12 12   ∴ P1 completed

    This system is in safe state and safe sequence
    is P0, P2, P3, P4, P1.

Q.3.
→

    First fit :
    220K → 500K (.280 left).
    430K → 550K (120 left).
    110K → 120K (10 left).
    425K → nowhere big enough left

    Best fit :
    220K → 300K (80 left).
    430K → 500K (70 left).
    110K → 150K (40 left).
    425K → 550K (125 left).

Q.3.

→ worst fit:

2 20k → 550k (330k left)

4 30k → 500k (70k left)

110k → 330k (220k left)

425k → no where big enough

Q.4.

→

1. Frame size = 3

FIFO page replacement

Number of Hits = 5 and miss = 15

Frame	6	0	5	2	0	3	0	4	2	3	0	3	2
0	6	6	6	2	2	2	2	4	4	4	0	0	0
1		0	0	0	0	3	3	3	2	2	2	2	2
2			5	5	5	5	5	0	0	0	3	3	3
PF	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	-	-

5	2	0	5	6	0	5
0	0	0	0	6	6	6
5	5	5	5	5	0	0
3	2	2	2	2	2	5
Y	Y	-	-	Y	Y	Y

Q.4

→ 2.   Optimal Page Replacement
Number of Hits = 12 and miss = 8

Frame	6	0	5	2	0	3	0	4	2	3	0	3
0	6	6	6	2	2	2	2	2	2	2	2	2
1		0	0	0	0	0	0	4	4	4	0	0
2			5	5	5	3	3	3	3	3	3	3
PF	Y.	Y	Y.	Y.	—	—	—	Y.	—	—	Y.	—

2	5	2	0	5	6	0	5
2	2	2	2	2	6	6	6
0	0	0	0	0	0	0	0
3	5	5	5	5	5	5	5
—	Y.	—	—	—	Y.	—	—

3   LRU Page Replacement
Number of Hits = 8   and miss = 12

Frame	6	0	5	2	0	3	0	4	2	3	0	3
0	6	6	6	2	2	2	2	4	4	4	0	0
1		0	0	0	0	0	0	0	0	3	3	3
2			5	5	5	3	3	3	2	2	2	2
PF	Y	Y	Y.	Y	—	Y.	—	Y.	Y.	Y.	Y.	—

2	5	2	0	5	6	0	0	5
0	5	5	5	5	5	5	5	5
3	3	3	0	0	0	0	0	0
2	2	2	2	2	6	6	6	6
—	Y.	—	Y.	—	Y.	Y	—	—

Q.5

→ Frame Size = 4.

Optimal Page Replacement

Number of Hits = 14 and miss = 6

Frame	2	0	3	0	4	2	3	0	3	2	7	2	0
0		2	2	2	2	2	2	2	2	2	2	2	2
1			0	0	0	0	0	0	0	0	0	0	0
2			3	3	3	3	3	3	3	3	7	7	7
3					4	4	4	4	4	4	4	4	4
PF	Y	Y	Y	—	Y	—	—	—	—	—	Y	—	—

7	5	0	7	5	7	0
2	2	2	2	2	2	2
0	0	0	0	0	0	0
7	7	7	7	7	7	7
4	5	5	5	5	5	5
—	Y	—	—	—	—	—

LRU page Replacement : Hits = 14 and miss = 6

Frame	2	0	3	0	4	2	3	0	3	2	7	2
0		2	2	2	2	2	2	2	2	2	2	2
1			0	0	0	0	0	0	0	0	0	0
2			3	3	3	3	3	3	3	3	3	3
3					4	4	4	4	4	4	7	7
PF	Y	Y	Y	—	Y	—	—	—	—	—	Y	—

0	7	5	0	7	5	7	0
2	2	2	2	2	2	2	2
0	0	0	0	0	0	0	0
3	3	5	5	5	5	5	5
7	7	7	7	7	7	7	7
-	-	4	-	-	-	-	-