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Section : 03

① Ans:-

	Allocation				Max				Available				Need			
	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4
P0	2	0	2	0	7	10	6	5	9	8	8	10	5	10	4	5
P1	1	5	3	3	6	7	9	8	10	13	11	13	5	2	6	5
P2	1	2	1	1	9	7	10	6	11	15	12	14	8	5	9	5
P3	5	0	5	1	10	5	5	8	16	15	17	15	5	5	0	7
P4	1	3	5	5	5	5	10	10	17	18	22	20	4	2	5	5
P5	3	0	4	1	8	5	8	8	20	18	26	21	5	5	4	7
									22	18	28	24				

P0 →   5, 10, 4, 5 > 9, 8, 8, 10 → Nothing

P1 →   5, 2, 6, 5 ≤ 9, 8, 8, 10 → Execute P1

P2 →   8, 5, 9, 5 ≤ 10, 13, 11, 13 → Execute P2

P3 →   5, 5, 0, 7 ≤ 11, 15, 12, 14 → Execute P3

P4 →   4, 2, 5, 5 ≤ 16, 15, 17, 15 → Execute P4

P5 →   5, 5, 4, 7 ≤ 17, 18, 22, 20 → Execute P5

P0 →   5, 10, 4, 5 ≤ 20, 18, 26, 21 → Execute P0

As there is a sequence which is
   < P1, P2, P3, P4, P5, P0 >

Therefore, the state is safe.

(ii)

Ans:- P3 arrives for [3, 0, 0, 4]

	Allocation				Max				Available				Need			
	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4
P0	2	0	2	0	7	10	6	5	6	8	8	6	5	10	4	5
P1	1	5	3	3	6	7	9	8	7	13	11	9	5	2	6	5
P2	1	2	1	1	9	7	10	6	15	13	16	14	8	5	9	5
P3	8	0	5	5	10	5	5	8	16	16	21	19	2	5	0	3
P4	1	3	5	5	5	5	10	10	19	16	25	20	4	2	5	5
P5	3	0	4	1	9	5	8	8	21	16	27	20	5	5	4	7
									22	18	28	21				

Here, Allocation$_{P3}$ ≤ Max$_{P3}$, so it is valid.

Also, Need$_{P3}$ ≤ Available, so it is granted.

Therefore,

P0 → 5 10 4 5 > 6 8 8 6 → Nothing

P1 → 5 2 6 5 ≤ 6 8 8 6 → Execute P1

P2 → 8 5 9 5 > 7 13 11 9 → Nothing

P3 → 2 5 0 3 ≤ 7 13 11 9 → Execute P3

P4 → 4 2 5 5 ≤ 15 13 16 14 → Execute P4

P5 → 5 5 4 7 ≤ 16 16 21 19 → Execute P5

P0 → 5 10 4 5 ≤ 15 16 21 19 → Execute P0

P2 → 8 5 9 5 ≤ 21 16 27 20 → Execute P2

As all the process are executed in the order $\langle P1, P3, P4, P5, P0, P2 \rangle$, the state remains safe.