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Assignment - 4

(Part - A)

Ans 1:- A race condition occurs when two actions happen at the same time the final result depends on who runs first.

Ex:- Two people booking movie tickets online

Fix:- Mutual Exclusion locks the shared resource

Ans 2:- Peterson's :- Pure Software, simple but works only on single-core; depends on strict (R) ordering

Semaphores : Require hardware atomic instruction more robust and scalable

Ans 3:- Monitors automatically manage locking, reducing errors and making synchronization easier and safer on multicore systems.

Ans 4:- Starvation occurs when continuous readers prevent waiting writers from ever getting access.

Fix:- Use write-priority or fair queueing so writers get scheduled eventually.

Ans 5. Drawback :- A process must request all resources upfront, causing low resource utilization and possible starvation.

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PART - B

Ans 6: Given Fragments

S_1 : $P_1 \rightarrow P_2$, $P_3 \rightarrow P_4$
S_2 : $P_2 \rightarrow P_5$, $P_5 \rightarrow P_6$
S_3 : $P_6 \rightarrow P_1$

(a) Global wait-for Graph
$P_1 \rightarrow P_2 \rightarrow P_5 \rightarrow P_6 \rightarrow P_1$ (cycle)
$P_3 \rightarrow P_4$ (no cycle)

(b) Deadlock:
Yes Deadlock cycle $\Rightarrow P_1, P_2, P_5, P_6$

(c) Distributed algo :-
Chandy - Misra - Haas probe-based deadlock detection

Ans 7: (a) Expected file access time
Remote probability = 0.3
Local probability = 0.7

$E = 0.7 \times 5 + 0.3 \times 25$
$E = 3.5 + 7.5 = 11 ms$

(b) Caching strategy
Client-side caching with LRU
reduces remote access frequency and lower latency

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Ans 8: (a) Optimal mix:-
Take one Full checkpoint every 10s + incremental checkpoint every 1s.

(b) Reasoning:-
Full checkpoint ensures a stable base
Frequent incremental checkpoints keep data loss under ≤ 1s while minimizing overhead.

Ans 9. Case Study:-

(a) Challenges: Sudden load spikes, uneven traffic, cross-region latency.
Solution: Dynamic load balancing using consistent hashing + autoscaling.

(b) Use active-active replication across regions, automated failover, frequent checkpoints, ensuring RTO/RPO targets even if a data centers fails.