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Subject → Operating System

Assignment - 4:

Part - A : Short Answer Type →  
From Q. (1 to 5) similar to Assignment  
Three From Q. (1 to 5).

Part - B : Application Numerical Based →  
Distributed Deadlock Detection →

(a) Global Wait - for Graph : From all sites combined :

$$P_1 \rightarrow P_2, P_3 \rightarrow P_4, P_2 \rightarrow P_5, P_5 \rightarrow P_6, P_6 \rightarrow P_1$$

(b) Deadlock Detection → There is a cycle :

$$P_1 \rightarrow P_2 \rightarrow P_5 \rightarrow P_6 \rightarrow P_1.$$

Thus, a deadlock exists involving  $P_1, P_2, P_5$  and  $P_6$ .

(c) Suitable distributed algorithm →

The Chandy - Misra - Mosco algorithm can be used,  
as it detects cycles in distributed wait-for graphs with minimal communication overhead.

② Distributed File System Performance, →

(a) Expected access time :

$$\begin{aligned} \text{Expected Time} &= (\text{Probability Local} \times \text{Local Time}) \\ &+ (\text{Probability Remote} \times \text{Remote Time}) \\ &= (0.7 \times 5 \text{ ms}) + (0.3 \times 25 \text{ ms}) \\ &= 3.5 \text{ ms} + 7.5 \text{ ms} = 11 \text{ ms} \end{aligned}$$

(b) Caching Strategy →

A client-side caching strategy with consistency checks can improve performance of frequently accessed remote files are stored locally, reducing access time and lowering average access time while maintaining correctness.

Q. 8

Checkpointing Strategy :  $\Rightarrow$

Full checkpoint = 200ms  
RPO = 1 second  
Period = 10 seconds

- (a) Optimal Mix :
- Use one full checkpoint at the beginning and then incremental checkpoints every 1 second.
  - This results in :  $1 \text{ full} + 9 \text{ incremental checkpoints}$ .

(b) Reasoning :

The incremental checkpoints ensure that no more than 1 second of work is lost, satisfying the RPO. The single full checkpoint provides a complete task state baseline while incremental checkpoints minimize overhead across remaining time.

Q. 9

Globol E - Commerce Platform Case Study  $\Rightarrow$

(a) Distributed scheduling challenges & suitable algorithm

During flash sales, request surges cause uneven load across servers & unpredictable arrival patterns, and potential bottlenecks due to geographic distribution.

A suitable algorithm is Dynamic Load Balancing using Least-Loaded or Work-Stealing approach, which continuously redistributes tasks based on real-time server load & ensuring efficient utilization.

(b) Fault tolerance strategy with RTO & RPO considerations  $\Rightarrow$

A combination of geo-redundancy and synchronous services ensures minimal data loss (Low RPO). That if one data center fails, another immediately takes over. For fast recovery (Low RTO), implement automatic failover through distributed coordination even during regional outages.