

## High Performance Computing – Additional Exam-Oriented Questions (16 Marks)

### UNIT 1 – INTRODUCTION TO PARALLEL COMPUTING

1. Explain the limitations of memory system performance and how they influence parallel computing.
2. Discuss different levels of parallelism with real-world examples.
3. Compare SIMD, MIMD, SIMT, SPMD, and Dataflow computational models.
4. Explain communication costs in parallel machines in detail.

### UNIT 2 – PARALLEL ALGORITHM DESIGN

1. Describe decomposition techniques with suitable examples.
2. Explain characteristics of tasks and interactions in parallel algorithms.
3. Discuss static and dynamic mapping techniques for load balancing.
4. Explain methods for reducing interaction overheads.

### UNIT 3 – MESSAGE PASSING PARADIGM

1. Explain blocking vs non-blocking message passing with examples.
2. Discuss MPI communicators and their significance.
3. Describe MPI collective communication operations in detail.
4. Explain how computation can be overlapped with communication in MPI.

### UNIT 4 – SYNCHRONIZATION

1. Explain different synchronization primitives in Pthreads.
2. Discuss job scheduling and dependency analysis in parallel systems.
3. Explain thread cancellation and composite synchronization constructs.
4. Describe OpenMP parallel constructs with examples.

### UNIT 5 – GPGPU & CUDA PROGRAMMING

1. Explain the SIMT model and GPU thread hierarchy.
2. Describe the CUDA memory hierarchy and its performance implications.
3. Discuss the DGX architecture and its relevance to HPC.
4. Explain steps involved in writing and launching a CUDA kernel.

### UNIT 6 – PERFORMANCE MEASURES

1. Explain speedup, efficiency, and scalability with numerical examples.
2. Describe the concept of work and critical path with diagrams.
3. Explain Amdahl's Law and its implications on scalability.
4. Compare abstract vs real performance factors in HPC systems.

