

12. (a) What is deadlock? Explain the four conditions for deadlock and present an example for deadlock in a parallel computing environment. (16)

Or

- (b) (i) Outline the critical section problem with an example. (6)
(ii) Explain how semaphores can be used to accomplish mutual exclusion of parallel-process synchronization with an example. (10)

13. (a) (i) Outline the OpenMp execution model. (8)
(ii) Discuss about OpenMp directives with relevant examples. (8)

Or

- (b) (i) What is loop-carried dependence? Explain with an example. (8)
(ii) Outline with an example the use of the greatest common divisor test to determine whether dependences exist in a loop. (8)

14. (a) Explain the structure of an MPI program with an example. (16)

Or

- (b) (i) Outline collective vs point-to-point communications in MPI with an example. (8)
(ii) What is a MPI derived data type? How to create a MPI derived data type? Give any two examples. (8)

15. (a) Outline the process of parallelizing depth-first search algorithm using OpenMP with an example. (16)

Or

- (b) Write a note on thread paradigm and compare OpenMP and MPI programming models. (16)