BE5-R4: PARALLEL COMPUTING

NOTE:

1. **Answer question 1 and any FOUR from questions 2 to 7.**
2. **Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours **Total Marks: 100**

1.

a) What are various criteria for classification of parallel computers?
b) Differentiate between UMA, NUMA and COMA.
c) What are the parameters based on which performance of interconnection network is measured?
d) Explain how QuickSort can be parallelized? What are the limitations in its parallel formation?
e) Define control and resource dependencies.
f) What are the limitations of Amdahl's law? State Gustafson-Barsis's Law.
g) Discuss some situations in which non-blocking receive is preferred over blocking receive?

(7x4)

2.

a) Explain each of the following terms commonly used in parallel computing in a few sentences each:
   i) Symmetric multiprocessor
   ii) Multicore
   iii) Clusters
   iv) GPU
b) Design an 8 x 8 single-stage recirculating Shuffle–Exchange network for Packet Switched Network.
c) What are the fundamental issues or design choice for MIMD architecture?

(8+4+6)

3.

a) Define Bitonic sequence. Discuss a Bitonic sorting algorithm. Further, using the algorithm, sort the following sequence: 15,17,19,20,25,27,29,34,37,18,16,13,10,8,7,6,2
b) Explain matrix multiplication using DNS Approach.

(10+8)

4.

a) i) What are the advantages of threading programming models over message-passing programming models?
   ii) Define the function
      a) pthread_create
      b) pthread_join
   iii) Explain how threaded APIs provide support for implementing critical sections and atomic operations.
b) What is used of following MPI function?
   i) MPI_Comm_rank
   ii) MPI_Reduce
   iii) MPI_Barrier
c) Write a short note on parallel random access machine (PRAM).

(7+6+5)

5.

a) How to decompose a task into subtasks in order to design parallel algorithm?

b) Why is the ratio of computation time versus communication time important for performance in distributed memory message passing systems? Is this metric useful when you can have overlapped computation and communication?

c) What are the differences between the functions pvm_initsend() and pvm_mkbuf()?

(10+5+3)

6.

a) Why do we have multi-core processors? Are not single-core processors good enough? Why is multi-core a disruptive technology from the point of view of parallel computing?

b) Is it ever reasonable to calculate speedup for P processors with respect to the execution time for P = 2? Explain.

c) Name three advantages of a shared memory parallel system over a distributed memory parallel system. Name three advantages of a distributed memory parallel system over a shared memory parallel system.

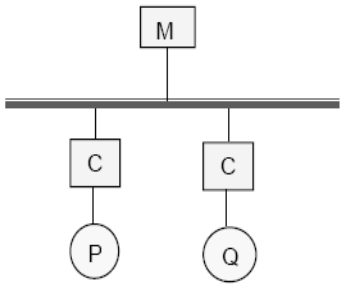
(6+6+6)

7.

a) i) Write a threaded program to compute π (pi) using the OpenMP for directive.

ii) What are the synchronization constructs in OpenMP? Explain.

b) Consider a bus based shared memory with 2 processors P and Q (shown in figure). Define invalidate write through protocol and explain how the cache coherence is maintained using it. Assume that X is memory was originally set to S and the following operations were performed in the order given:



i) P reads X
ii) Q reads X
ii) Q updates X
iv) Q reads X
v) Q updates X
vi) P updates X
vii) Q reads X

c) What is a “hybrid” and “adaptive” parallel algorithm?

(9+6+3)