

BE5-R3: PARALLEL COMPUTING

NOTE:

1. Answer question 1 and any FOUR questions from 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) Is it possible for the average speedup exhibited by a parallel algorithm to be super-linear? Justify your answer.
- b) Comment on the statement: " Any computer with I/O channel is a multiprocessor".
- c) What are different types of memory interleaving schemes? Which scheme is suitable for pipelined vector processor?
- d) Is a multi-programmed operating system running on a multiprocessor an implementation of a parallel algorithm? Justify.
- e) Distinguish between implicit and explicit parallel computational models.
- f) Explain the situations under which cache coherence problem can arise.
- g) Comment on the statement: "Parallelism by message passing."

(7x4)

2.

- a) Define interconnection network. How will you compare different interconnection networks?
- b) Write algorithms to configure the 2x2 switches of an 8x8 multistage shuffle-exchange interconnection network in establishing routing path between source port i and destination port j . Use both XOR and destination tag routing schemes.
- c) What do you mean by permutation capability of any interconnection network? How can you increase the same for any blocking interconnection network?

(5+8+5)

3.

- a) Compare and contrast the following three message passing OS models:
Node-addressed model, Channel-addressed model and Object-oriented model.
- b) Is the calculation on $n!$ parallelizable? If no, then why? If yes, then how?
- c) Explain the advantages and disadvantages of multithreaded UNIX kernel.

(8+6+4)

4.

- a) Explain Bitonic sorting scheme and discuss its complexities.
- b) Suggest a suitable SIMD algorithm to multiply two $(n \times n)$ matrices using $(n \times n \times n)$ number of processors. Assume suitable value of n . Comment on the time complexity of your algorithm.

(9+9)

5. Briefly explain the following performance measuring laws:

- a) Fixed-work load speed up (Amdahl's Law)
- b) Fixed-time speed up (Gustafson's Law)
- c) Memory-bound speed up (Sun-Ni Law)

(6+6+6)

6. Consider the following program segment:

```
      DO I = 1, N
        DO J = 2, N
S1:          A(I,J) = B(I,J) + C(I,J)
S2:          C(I,J) = D(I,J) / 2
S3:          E(I,J) = A(I,J-1) ** 2 + E(I,J-1)
        Enddo
      Enddo
```

- a) Show all data dependences among the statements.
- b) Show how to parallelize the loop scheduling the parallelizable iterations to concurrent processors.

(8+10)

7.

- a) Comment on the data-parallel paradigm in parallel computing environment with suitable examples.
- b) What is the worst-case time complexity of parallel quick-sort algorithm? Justify your answer.

(10+8)