Registration No: | | | | | | | | | | |

Total Number of Pages: 02 **B.Tech.**
PCS5J104

5th Semester Regular Examination 2017-18
Parallel Algorithms
BRANCH: CSE
Time: 3 Hours
Max Marks: 100
Q.CODE: B316

Answer Question No.1 and 2 which are compulsory and any four from the rest.
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions: *multiple type or dash fill up type*** **(2 x 10)**

a) The diameter of crossbar network is _____.
(i) 1 (ii) log p (iii) 2 log p (iv) log log p

b) Which one of the following is not a single program multiple data platform?
(i) Sun Ultra Server (ii) Multiprocessor PCs (iii) IBM SP (iv) Illiac IV

c) A d-dimensional hypercube is constructed by connecting corresponding nodes of two _____ dimensional hypercubes.
(i) d + 1 (ii) d – 1 (iii) d + 2 (iv) d - 2

d) The diameter of completely-connected network is ____.
(i) 1 (ii) 2 (iii) 4 (iv) 8

e) Which one is not true?
(i) The development of PVM started in 1989 at ORNL.
(ii)The development of MPI started in 1992 by MPI Forum.
(iii) PVM and MPI does not support heterogeneity.
(iv) PVM has daemon running on all computers making up the virtual machine.

f) Which one is not a parallel algorithm model?
(i) Master slave model (ii) Work pool model (iii) Task graph model (iv) Processor graph model

g) Which one of the parallel algorithm model is suitable for shared-address-space?
(i) Master slave model (ii) Work pool model (iii) Task graph model (iv) Processor graph model

h) The number of bits that can be communicated simultaneously over a link connecting two nodes is called the _____.
(i) Channel bandwidth (ii) Channel width (iii) Channel rate (iv) Channel connectivity

i) Which method is not used to implement the PRAM model?
(i) Shared memory model (ii) Message passing model (iii) Information passing model (iv) Data parallel model

j) The distance between any two nodes in the bus-based network is ___.
(i) O(1)
(ii) O(p) where p is the number of processors
(iii) O(b) where b is the number of memory banks
(iv) O(pb)

Q2 **Answer the following questions: *Short answer type*** **(2 x 10)**

a) Define Moore's law.

b) List out two scientific applications of parallel computing.

c) How increasing comparator is different from decreasing comparator?

d) List out the similarities and dissimilarities between superscalar architecture and super pipelined architecture.

e) Distinguish between pipelining and parallelism.

f) What do you mean by Bitonic sequence?

g) What is hit ratio? What do you mean by memory bound computations?

h) How to evaluate dynamic interconnection network?

i) Show a complete omega network connecting eight processors and eight memory banks.

j) How deterministic routing is different from adaptive routing?

Q3 **a)** Let A and B be two nodes in a d-dimensional hypercube. Define H(A, B) to be the Hamming distance between A and B and P(A, B) to be the number of distinct paths connecting A and B. These paths are called parallel paths and have no common nodes other than A and B. Prove the following: **(10)**
(i) The minimum distance in terms of communication links between A and B is given by H(A, B).
(ii) The total number of parallel paths between any two nodes is P(A, B) = d.
(iii) The length of the remaining d – H(A, B) parallel paths is H(A, B) + 2.

b) List three major problems requiring the use of supercomputing/high performance computing in the following domains: **(5)**
(i) Structural mechanics (ii) Computational biology (iii) Commercial applications.

Q4 **a)** In the below mentioned algorithm, assume a decomposition such that each execution of Line 7 is a task. Draw a task-dependency graph and a task-interaction graph. **(10)**

```
1. procedure FFT_like_pattern(A, n)
2. begin
3.    m := log2 n;
4.    for j := 0 to m - 1 do
5.       k := 2^j;
6.       for i := 0 to n – 1 do
7.          A[i] := A[i] + A[i XOR 2^j];
8.       endfor
9.    endfor
10. end FFT_like_pattern
```

b) In Q4 (a) algorithm, if n = 16, devise a good mapping for 16 processes. **(5)**

Q5 **a)** Consider seven tasks with running times of 1, 2, 3, 4, 5, 5 and 10 units, respectively. Assuming that it does not take any time to assign work to a process, compute the best- and worst-case speedup for a centralized scheme for dynamic mapping with two processes. **(10)**

b) Why is it difficult to construct a true shared-memory computer? What is the minimum number of switches for connecting p processors to a shared memory with b words where each word can be accessed independently? **(5)**

Q6 **a)** Define and prove Amdahl's law. **(10)**

b) Write a MPI program with suitable MPI functions to print "Hello World" message from each processor. **(5)**

Q7 **a)** Explain the following performance metrics for parallel systems. **(10)**
(i) Execution time (ii) Total parallel overhead (iii) Speedup (iv) Efficiency (v) Cost

b) Explain the process of multiplying an n × n matrix with an n × 1 vector using rowwise block 1-D partitioning. Note that for the one-row-per-process case, p = n. **(5)**

Q8 **a)** Explain various issues in sorting on parallel computers. **(10)**

b) Discuss a parallel algorithm for multiplying two n × n dense, square matrices A and B to yield the product matrix C = A × B. **(5)**

Q9 **a)** Give the sequential quicksort algorithm with complexity analysis. Explain various ways to parallelize quicksort algorithm. **(10)**

b) Consider a three-dimensional hypercube. Let P_s and P_d be the labels of the source and destination nodes and P_s = 010 and P_d = 111. Discuss the routing mechanism from node P_s to node P_d using E-cube routing with suitable diagrams. **(5)**