*University of Hyderabad, Department of Computer and Information Sciences*

# CS726-Parallel Computing

**Max. Marks: 60** **Date: November 24, 2008**
**Duration: 3 Hrs.**

**Note:**
1. Attempt **all** questions
2. Each question contains **3** sub questions. Attempt **any and only 2** questions
3. Figure to the right indicates maximum marks
4. In case of any doubt, mention your assumptions in the answer-book and proceed for your answers

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**Q.1 (A)** Explain P-RAM model of Computation, how do you retain the same parallel time complexity of an algorithm even after reducing the number of processors?

**(B)** Write a C/MPI parallel program to calculate value of **pi** by numerical integration.

**(C)** "**N** threads are to be created, each taking numbers from the list to add to their partial sums. When all numbers have been taken, the threads can add their partial results to a shared location **sum**. A shared loacation **global_index** can be used by each thread to select next element of **a[ ]**", write a pthread based program for it.

**Q.2 (A)** What criteria are used understand effectiveness in implementing efficient parallel algorithms on real architecture? Explain it in terms of the Mesh Networks.

**(B)** Devise a parallel algorithm for finding $x^n$ (x power n) using balanced binary tree technique. What is the parallel time and processors complexity of your algorithm?

**(C)** What is cluster, what are the prominent components of cluster? How do you classify them?

**Q.3 (A)** Explain how cache coherency problem is handled in NUMA architecture?

**(B)** How do use Foster's Design Methodology to solve the problem of multiplying two $n \times n$ matrices.

**(C)** n = $2^m$ numbers stored in an array A of dimension (2n-1) from A(n), A(n+1),...,A(2n-1). Write a parallel algorithm for obtaining the prefix sum of these numbers, at the end A(i), $1 \leq i \leq n$ stores the result. What is the parallel time and processor's complexity?

**Q.4 (A)** With suitable diagram explain the working of Processor Arrays.

**(B)** Propose a parallel algorithm for ***Satisfiability problem*** with ***k*** variables (or negation), represented in CNF or DNF formula. How many processors are needed to achieve ***k*** time parallel complexity?

**(C)** "Each process has an array of 30 doubles, in C. For each of the 30 locations, compute the value and rank of the process containing the largest value", write a C/MPI program to accomplish the task.

**Q. 5(A)** Comment on the working behavior of the following program segment assuming there is no syntax error:

```
switch(rank) {
case 0:
      MPI_Bcast(buf1, count, type, 0, comm);
      MPI_Send(buf2, count, type, 1, tag, comm);
      break;
case 1:
       MPI_Recv(buf2, count, type, 0, tag, comm, status);
       MPI_Bcast(buf1, count, type, 0, comm);
      break;
}
```

**(B)** Propose a parallel algorithm for the bucket sort; discuss its parallel time and processor's complexity.

**(C)** Define followings:

i. Throughput of a device
ii. Parallel Processing
iii. Amdahl's law
iv. Speedup
v. Efficient Parallel Program
vi. Statement of Brent's theorem

***------Best of Luck------***