University of Hyderabad, Department of Computer and Information Sciences

Parallel Computing

Max. Marks: 60 **Date: January 10, 2011**

Duration 3.00 Hrs.

Note: 1. Attempt **any and only ten** questions, all carry equal marks.
2. Draw neat diagrams, if needed.

Q.1 Explain the Butterfly Network of processor? How do you decompose this network? Explain with one example.

Q.2 What is the ***Race Condition***? Explain in context to shared memory programming.

Q.3 Explain the role of ***diameter*** and ***bisection-width*** that is used to understand effectiveness in implementing efficient parallel algorithms on cube connected multiprocessor system?

Q.4 Consider the following program segment of an Open_MP program and comment on the execution.

```
#include <stdio.h>
int main(int argc, char *argv[])
{
      int i = 0, j = 0;
      int result = 0;
      #pragma omp parallel for private(i) reduction(+:result)
      for (i = 0; i < 3; i++) {
          for (j = i + 1 ; j < 4; j++) {
               printf("Hello.\n");
               #pragma omp critical
               result = result + 1;
           }
       }
      printf("Number of times printed Hello = %d\n", result);
}
```

Q.5 If $n = 2^m$ numbers stored in an array A of dimension (2n-1) from A[n], A[n+1],..., A[2n-1]. Write a PRAM algorithm to compute prefix product such that at the end A[i] stores A[1]*A[2]*....*A[i].

Q.6 What are the qualifiers used to explicitly qualify variables in a parallel loop of an OpenMp program. Explain working of any two.

Q.7 What are the alternatives for programming shared memory multiprocessors. Which one is better and why?

Q.8 With a proper diagram explain the ***cluster system architecture***.

Q. 9 Explain the working behavior of the following program segment and write your comments. Assume that there is no syntax error in the program segment.

```
int a[10], b[10], npes, myrank;
MPI_status status;
…
MPI_Comm_size(MPI_COMM_WORLD, &npes);
MPI_Comm_rank(MPI_COMM_WORLD, &myrank);
MPI_Send(a, 10, MPI_INT, (myrank+1)%npes, 1, MPI_COMM_WORLD);
MPI_Recv(b, 10, MPI_INT, (myrank-1+npes)%npes, 1, MPI_COMM_WORLD);
…
```

Q.10 Devise a parallel algorithm for multiplying two $n \times n$ matrices. What is the parallel time and processors complexity?

Q.11 How do you compute the integration of a given function using mean value theorem? Propose a multithreaded program for your algorithm.

Q.12 Explain the ***P-RAM*** model of computation. Which realistic machine uses this model of computation? Why does it reduce the complexity of a sequential algorithm?

Q.13 Define:

i. Efficient parallel algorithm
ii. Optimal parallel algorithm
iii. Brent's theorem
iv. Amdhal's law

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