Parallel Computing

Max. Marks: 60 **Date: January 5, 2009**
Duration 3.00 Hrs.

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

Q.1 Consider the following program segment of an Open_MP program and comment on the execution. **[6]**

```
#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 < 5; i++) {
        for (j = i + 1 ; j < 5; j++) {
            printf("HCU\n");
            #pragma omp critical
            result = result + 1;
        }
    }
    printf("Number of times printed HCU is = %d\n", result);
}
```

Q.2 Explain how write conflicts in ***P-RAM*** model of computation are handled? Which realistic machine uses ***P-RAM*** model of computation? **[6]**

Q.3 Write a multithreaded program to find numerical integration using trapezoidal rule ($S = \sum_{i=1}^{n} \frac{(f_i + f_{i+1})}{2} * h$). The different threads compute intermediate values, x_1 and x_2 are two end points of the interval where the function value of f_1 and f_2 is calculated, h is a step size. Use a condition variable to recognize when each thread completed its designated computation. **[6]**

Q.4 Develop a row-oriented message passing parallel program to multiply two $n \times n$ matrices. Obtain its parallel time complexity. **[6]**

Q.5 Propose a PRAM algorithm to compute prefix sum of n number. What is the time complexity of your algorithm **[6]**

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

Q.7 With a proper diagram explain the ***cluster system architecture***. **[6]**

Q.8 Show that the total number of processors in a Pyramid Network of size k^2 is $(4/3)k^2 - (1/3)$. **[6]**

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. **[6]**

```
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 Explain the shuffle Exchange network of processors. **[6]**

Q.11 Devise a parallel algorithm for finding x^n (x power n) using balanced binary tree technique. What is the parallel time and processors complexity? **[6]**

Q.12 List Advantages and Disadvantages of using asymmetrical multi-computers. **[6]**

Q.13 Define: **[6]**

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

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