Mahindra University, Hyderabad
Ecole Centrale School of Engineering
Mid-Term Examination

Subject: High-Performance Computing (MA3102)

Program: B.Tech **Year: III** **Branch: CM**

Date: 23-10-2024 **Start Time: 10:00**

Duration: 90 minutes **Max. Marks: 100**

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1. Open book examination. Students can attend the exam with the textbook "The Art of Multiprocessor Programming" by Maurice Herlihy, Nir Shavit, Victor Luchangco, and Michael Spear.
2. Answer all questions

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1. You are given a program that contains a method **M** and it executes in sequential and the remaining code of the program can be executed in parallel on a 14-core machine. Assume that **M** accounts for 30% of the program's execution time. Use Amdahl's Law to answer the following questions:

   (a) What is the limit for the overall speedup that can be achieved ?

   (10 Marks)

   (b) You hire a programmer to replace **M** with M^1 and it holds $k - fold$ speedup over M. Assume that the method M^1 should be executed in sequential. What value of k the program yields $5\times$ speedup ?.

   (20 Marks)

2. Give a multi-threaded algorithm to multiply two matrices of order $n \times n$. Analyze your algorithm.

   (20 Marks)

3. Consider N processes numbered 0 to $N-1$ in which each process i executes:

   $$A[i] = 1$$
   $$B[i] = A[(i-1)\ mod\ N]$$

   If all the reads and writes to $A[i]$ are atomic, what can you say about the values in B at the end when all processes are done. Assume that the arrays A and B are shared by all processes.

   (20 Marks)

4. Suppose you developed a concurrent linked list by using a lock with name ABC. You claimed that the lock satisfies mutual exclusion property and starvation-free property, and it works for any number of threads. Your faculty member wants to see the pseudocode of ABC lock. Please write the pseudocode.

   (30 Marks)