Subject Name : Parallel Processing
Subject Code : CE 606-3 / IT 606-3

Teaching Scheme (Credits and Hours)

Teaching scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
03	00	04	07	5	3	70	30	20	30	150

Learning Objectives:

This is a graduate level course on parallel computing with the objective to familiarize students with the fundamental concepts, techniques and tools of parallel computing. Participation in this course will enable you to better use parallel computing in your application area, and will prepare you to take advanced courses in more specific areas of parallel computing.

Outline of the Course:

Sr. No	Title of the Unit	Minimum Hours
1	Introduction	4
2	Processes & Shared Memory Programming	5
3	Basic Parallel Programming Techniques	5
4	Scheduling	6
5	Barriers And Race Conditions	4
6	Thread-Based Implementation	7
7	Programming Using the Message Passing Paradigm	7
8	Algorithms For Parallel Machines	7

Total hours (Theory): 45
Total hours (Lab): 60
Total hours: 105

Detailed Syllabus:

Sr. No	Topic	Lecture Hours	Weightage (%)
1	**Introduction:** Parallel Processing – Shared Memory Multiprocessing – Distributed Shared Memory – Message Passing Parallel Computers.	4	10
2	**Processes & Shared Memory Programming** Processes - Shared Memory Programming – General Model Of Shared Memory Programming – Forking-Creating Processes – Joining Processes - Process Model Under UNIX.	5	10
3	**Basic Parallel Programming Techniques:** Loop Splitting – Ideal Speedup – Spin-Locks, Contention And Self-Scheduling.	5	10
4	**Scheduling :** Loop Scheduling – Variations On Loop Scheduling – Self-Scheduling – Variations On Self-Scheduling – Indirect Scheduling – Block Scheduling.	6	15
5	**Barriers And Race Conditions** The Barrier Calls – Expression Splitting.	4	10
6	**Thread-Based Implementation** Thread Management – The POSIX Thread Application Programmer Interface- Synchronization Primitives in POSIX- Example With Threads – Attributes Of Threads – Mutual Exclusion With Threads – Mutex Usage Of Threads – Thread Implementation – Events And Condition Variables – Deviation Computation With Threads – Java Threads.	7	15
7	**Programming Using the Message Passing Paradigm** Principles of Message-Passing Programming. The Building Blocks: Send and Receive Operations. MPI: The Message Passing Interface. Topologies and Embedding. Overlapping Communication with Computation. Collective Communication and Computation Operations.	7	15
8	**Algorithms For Parallel Machines** Models Of Computation – Analysis Of Parallel Algorithms – Prefix Computation – Histogram Computation – Parallel Reduction – Sorting Networks - Matrix Multiplication	7	15
	Total	**45**	**100**

Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lecture and laboratory which carries 10 marks in overall evaluation.
- One internal exam will be conducted as a part of internal theory evaluation.

- Assignments based on the course content will be given to the students for each unit and will be evaluated at regular interval evaluation.
- Surprise tests/Quizzes/Seminar/tutorial will be conducted having a share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments shall be performed in the laboratory related to course contents.

Learning Outcome:

At the end of the course the students will be able to do following:

- Understand the evolution of High Performance Computing (HPC) with respect to laws and the contemporary notion that involves mobility for data, hardware devices and software agents
- Understand, appreciate and apply parallel and distributed algorithms in problem Solving.
- Evaluate the impact of network topology on parallel/distributed algorithm formulations and traffic their performance.
- Gain hand-on experience with the agent-based and Internet-based parallel and distributed programming techniques.
- Master skills to measure the performance of parallel and distributed programs.

Text Books:

1 Introduction To Parallel Programming - By Steven Brawer.
2 Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, By Pearson Publication.
3 Introduction To Parallel Processing – By M.Sasikumar, Dinesh Shikhare And P. Ravi Prakash.

List of experiments:

No.	Aim of Practical
1.	1) Write a c program to create child process and print the process id and parent process id using fork function.
	2) Write a c program to create orphan process.
	3) Write a c program to create zombie process.
2.	Write a ‘c’ header file for sharing and free the memory.
3.	**Shared memory program model -1.** 1) Write a program of array addition.
	2) Write a program of matrix multiplication.
4.	**Shared memory program model -2.** 1) Write a program to calculate factorial of a given number.

	2) Write a program to calculate the sum of 1 to n numbers.
5.	**Shared memory program model -3.** 1) Write a c program for summation of array elements using loop splitting.
	2) Write a c program for summation of array elements using self scheduling.
6.	**Shared memory program model -4.** 1) Write a program to calculate standard deviation with barriers.
	2) Write a program to create histogram using multiple barriers.
7.	1) Write a program to create and join thread.
	2) Write a program that calculates the sum of array with n elements.
8.	1) Write a program to calculate standard deviation of n numbers using thread.
	2) Write a program to produce consumer problem.
9.	Write a program for matrix multiplication using indirect scheduling.
10	Write a c program to solving the dependency in the linear recurrence relation x[i]=x[i-1]+y[i] using block scheduling.