Capital University of Science and Technology

Department of Computer Science

CS3433 - Parallel and Distributed Computing

Course Title:	Parallel and Distributed Computing (CS3433)
Pre-requisite(s):	Operating System (CS3413)
Credit Hours:	3
Instructor(s):	
Text Book(s):	An Introduction to Parallel Programming, Peter S. Pacheco, Elsevier
Reference Book(s):	• Introduction to Parallel Computing, by Kumar, Grama, Gupta and Karypis, Benjamin Cummings Publishing Co., 2nd Ed. • Distributed Systems, Third edition, by Maarten van Steen, Andrew S. Tanenbaum.
Web Reference:	• https://canvas.du.edu/courses/27613/assignments/syllabus

Course Introduction:

This course covers general introductory concepts in the design and implementation of parallel and distributed systems, covering all the major concepts. The specific topics that this course will cover are: Asynchronous/synchronous computation/communication, concurrency control, fault tolerance, GPU architecture and programming, heterogeneity, interconnection topologies, load balancing, memory consistency model, memory hierarchies, Message passing interface (MPI), MIMD/SIMD, multithreaded programming, parallel algorithms & architectures, parallel I/O, performance analysis and tuning, power, programming models (data parallel, task parallel, process-centric, shared/distributed memory), scalability and performance studies, scheduling, storage systems, synchronization, and tools (Cuda, Swift, Globus, Condor, Amazon AWS, OpenStack, Cilk, gdb, threads, MPICH, OpenMP, Hadoop, FUSE).

Course Objectives:

Students will learn about parallel and distributed computers. They will be able to write portable programs for parallel or distributed architectures using Message-Passing Interface (MPI) library

Course Learning Outcomes (CLOs):

At the end of this course, the students should be able to:

CLO1: Explain fundamental parallel computing concepts. [C1 Remembering]

CLO2: Conceptualize analytical modeling and performance of parallel programs [C2 Understanding]

CLO3: **Design** parallel programs for distributed and shared memory architectures using Message- Passing Interface (MPI) and with OpenMP respectively [C3 Applying]

CLOs – PLOs Mapping:

	CLO:1	**CLO:2**	**CLO:3**
PLO:1 (Academic Education)			
PLO:2 (Knowledge for Solving Computing Problems)	√		
PLO:3 (Problem Analysis)		√	
PLO:4 (Design/Development of Solutions)			√
PLO:5 (Modern Tool Usage)			

Course Contents:

Week	**Contents**
1	Introduction to Parallel and Distributed Computing
2	Parallel Computer Memory Architectures Designing Parallel Programs

3	parallel algorithms & architectures, parallel I/O
4	Designing a parallel solution using Foster's methodology Counting Numbers, Histogram
5	Calculation of cost of a parallel program, Introduction to Distributed parallel Programming using MPI
6	Basic Construct of an MPI program and communication function send and receive
7	Introduction to the Trapezoidal rule, Serial program of Trapezoidal rule, Creating a parallel version of the trapezoidal rule
8	Improving the communication in the parallel programs using Collective communication functions
Mid-Term Exam	
9	Collective communication functions for customized ranges by taking a look at Matrix Multiplication
10	MPI Derived Data Types
11	Performance evaluation of MPI programs
12	Parallel Sorting Algorithms Safety in MPI parallel programs
13	Parallel Programming in Shared memory Systems using Open MP
14	Implementation of OpenMP programs and error checking
15	Variable scope of parallel programs, Reduction clause, Parallel For Directive
16	Analysis of data dependencies and loop carried dependencies

Grading Policy:

S.No	Grading	% of Total Marks
1	Assignments	20
2	Quizzes	20
4	Mid-term Exam	20
5	Final Exam	40
	Total	**100**