



National Computing Education Accreditation Council NCEAC



NCEAC.DOC.001-E

COURSE DESCRIPTION

NAME OF INSTITUTION	Lahore Garrison University
PROGRAM (S) TO BE EVALUATED	Computer Science , Spring 2022

Course Description : This is an introductory course in Parallel and Distributed Computing. It is the study of how to build a computer system where the state of the program is divided over more than one machine (or "node").

Course Code	CSC320																		
Course Title	Parallel and distributed Computing																		
Credit Hours	3+0																		
Prerequisites by Course(s) and Topics	Operating Systems																		
Assessment Instruments with Weights (homework, quizzes, midterms, final, programming assignments, lab work, etc.)	SESSIONAL (Quizzes, Assignments, Presentations) =25 % Midterm Exam =25 % Final Exam = 50%																		
Course Coordinator	Mr. Muhammad Arsalan Raza																		
URL (if any)	NA																		
Current Catalog Description	NA																		
Textbook (or Laboratory Manual for Laboratory Courses)	Distributed Systems: Principles and Paradigms, A. S. Tanenbaum and M. V. Steen, Prentice Hall, 2nd Edition, 2007																		
Reference Material	Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet, K Hwang, J Dongarra and GC. C. Fox, Elsevier, 1st Ed.																		
Course Goals	This course is to provide a combined applied and theoretical background in Parallel and Distributed Computing to improve students' learning outcomes. 1. Learn about parallel and distributed computers. 2. Write portable programs for parallel or distributed architectures using Message-Passing Interface (MPI) library. 3. Analytical modeling and performance of parallel programs. 4. Analyze complex problems with shared memory programming with OpenMP.																		
Course Learning Outcomes (CLOs):	<table><tr><th>At the end of the course the students will be able to:</th><th>Domain</th><th>BT Level*</th></tr><tr><td>Learn about parallel and distributed computers.</td><td>C</td><td>2</td></tr><tr><td>Write portable programs for parallel or distributed architectures using Message-Passing Interface (MPI) library.</td><td>P</td><td>3</td></tr><tr><td>Analytical modelling and performance of parallel programs.</td><td>C</td><td>3</td></tr><tr><td>Analyze complex problems with shared memory programming with openMP.</td><td>C</td><td>4</td></tr><tr><td colspan="2">* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain</td><td></td></tr></table>	At the end of the course the students will be able to:	Domain	BT Level*	Learn about parallel and distributed computers.	C	2	Write portable programs for parallel or distributed architectures using Message-Passing Interface (MPI) library.	P	3	Analytical modelling and performance of parallel programs.	C	3	Analyze complex problems with shared memory programming with openMP.	C	4	* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		
At the end of the course the students will be able to:	Domain	BT Level*																	
Learn about parallel and distributed computers.	C	2																	
Write portable programs for parallel or distributed architectures using Message-Passing Interface (MPI) library.	P	3																	
Analytical modelling and performance of parallel programs.	C	3																	
Analyze complex problems with shared memory programming with openMP.	C	4																	
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain																			

Topics Covered in the Course, with Number of Lectures on Each Topic (assume 15-week instruction and one-hour lectures)	Week	Lecture	Topics Covered
	Week 1	1	Distributed systems and types
		2	Parallel computing in distributed systems
	Week 2	3	Asynchronous communication/computation
		4	Synchronous communication/computation
	Week 3	5	Transactions in distributed data stores and types
		6	Writeahead Log and serializability in transactions
	Week 4	7	Fault Tolerance and dependable systems
		8	Faults, errors, and failures in distributed systems
	Week 5	9	Load Balancing and Application Delivery Controller
		10	Flynn's Taxonomy and Computation Models
	Week 6	11	Modern CPU and GPU architectures
		12	General Purpose GPUs, Special Purpose GPUs, and IBM Cell Broadband Engine
	Week 7	13	AMD and NVIDIA General Purpose GPUs, AMD 7000-series HD7970 and NVIDIA GTX 480
		14	GPUs development libraries
	Week 8	1 hours	Mid Term
	Week 9	15	Heterogeneity, Goals, and Forms of Heterogeneity
		16	Parallel Virtual Machine PVM, Fault Tolerance scheme of PVM
	Week 10	17	Interconnection Topologies, 3D Hypercubes
		18	2D Mesh with 16-Nodes and Direct Memory Access, Diminishing role of topology
	Week 11	19	Multicore Programming, Concurrency vs. Parallelism, Types of Parallelism
		20	Parallel Systems, Performance metrics of Parallel systems, Runtime, Speedup, Efficiency, & Cost
	Week 12	21	Scalability of Parallel Systems, Amdahl's Law (1967), Gustafson's Law (1988)
		22	Iso-efficiency metrics of Scalability, Sources of Parallel Overhead
	Week 13	23	Memory Models, Shared and Distributed, The Message Passing Interface MPI, Sockets interface, primitives
		24	Programming interface, C/C++ MPI program
	Week 14	25	MPI C# programming, Communicator namespace, Properties: Size & Rank, Types: World & Self
		26	MPI C# Communication between processes, Point-to-point & Collective.
	Week 15	27	OpenMP models UMA, NUMA, Goals, Essentials
		28	Parallel Programming Models, Data parallel model, Task graph
	Week 16	29	Parallel programming model, Work pool, Master slave, producer consumer model, hybrid
		30	Brainstorming scenarios
	Week 17	2 hours	Final Term
Laboratory Projects/Experiments Done in the Course	Lab is not associated with this course.		
Programming Assignments Done in the Course	Implementation of parallel processing concepts using multi-threaded and Message Passing Interface (MPI) based applications. Covering both; shared memory and message passing models.		

Instructor Name	Mr. Muhammad Arsalan Raza
Instructor Signature	
Date	