ESD 5235: Multicore Program Optimization	L	Т	Р	С	Total hours
	3	0	0	3	36

Course Outcome

- 1. Distinguish between single core, multicore architectures, various architectures, trends, various levels of parallelisms.
- 2. Illustrate Various cache coherence, issues, memory consistency models, various protocols, working principles, performances.
- 3. Analyse Justification of primitives, optimizations, applications.

Unit	Topics	No. of Hours
l	Introduction to parallel computers: Introduction, why parallel architecture, application	1
	trends, technology trends, architectural trends	
II	Instruction Level Parallelism (ILP)	1
III	Cache memory	5
	Shared Memory Multiprocessors: General architecture, Introduction to Interconnect,	
	communication latency Problem of cache coherence; memory consistency models: SC,	
IV	PC, TSO, PSO, WO/WC, RC; snoopy protocol: invalidate vs. update, MSI, MESI, MOESI,	13
	MOSI; performance trade-offs; synchronization primitives: atomic primitives; locks: TTS,	13
	tickets, array; barriers: central and tree; performance implications in shared memory	
	programs; chip multiprocessors: why CMP (Moore's law, wire delay); shared L2 vs. tiled	
	CMP; core complexity; power/performance	
٧	Introduction to Basic optimization: Hotspot, Faster Algorithms, ILP, Data Dependency,	2
	Branching, Memory, Loops, Slow Operations	
	Introduction to Performance Tools (Intel Software Tools): Benchmark, Optimizing	
VI	Compilers, Profilers, Performance Tools, Code Coverage Tools, Sampling vs	2
	Instrumentation	
VII	Introduction to Multicore Optimization: ILP vs TLP, Data vs Task Parallelism, Parallel	2
	Application Case Studies, Parallelization Process	_
VIII	Programming for Performance: Partitioning for performance, Data Access and	2
	Communication, Orchestration, Performance factors, Case-Studies	_

		MultiThreading with Open MP: Threading, High Level vs Low Level Threading,		
IX	X	Threading Goals and Issues, Introduction to OpenMP pragmas, Execution Model and		
		Memory Model, Advanced OpenMP Topics		
Х	(Multithreaded Applications: Some applications in Integer Programming, Digital Signal	4	
		Processing (Video Codec)		

References

- The Software Optimization Cookbook High Performance Recipes for IA-32 Platforms, Richard Gerber, Aart J.
 C Bik, Kevin B. Smith, and Xinmin Tian, 2nd Edition, Intel Press
- 2. JComputer Architecture: A Quantitative Approach, Morgan Kaufmann Publishers,. L. Hennesey and D. A. Patterson. 3rd Edition
- 3. Parallel Computer Architecture: A Hardware/Software Approach. Morgan Kaufmann Publishers, D.E. Culler, J. P. Singh, with A. Gupta, 2nd Edition
- 4. Introduction to Concurrent Programming with GPUs | Coursera

ESD 5285: Multicore Program Optimization Lab	L	Т	Р	С	Total hours
	0	0	3	1	36

Course Outcome

- 1. Understand the performance variation between single core and multicore computing.
- 2. Practice parallelism using POSIX thread and openMP.
- 3. Use the performance tools to understand the application benchmarking, optimization.

Unit	Topics	
I	Writing the function for large dataset to understand the performance variation between single core and multicore computing.	3
II	Introduction to POSIX threads and openMP libraries.	6
III	Practice parallelism using POSIX thread and openMP.	18
IV	Understanding the performance tools.	9

References

The Software Optimization Cookbook High Performance Recipes for IA-32 Platforms, Richard Gerber, Aart J.
 C Bik, Kevin B. Smith, and Xinmin Tian, 2nd Edition, Intel Press

- 2. JComputer Architecture: A Quantitative Approach, Morgan Kaufmann Publishers,. L. Hennesey and D. A. Patterson. 3rd Edition
- 3. Parallel Computer Architecture: A Hardware/Software Approach. Morgan Kaufmann Publishers, D.E. Culler, J. P. Singh, with A. Gupta, 2nd Edition