

Branch Name:	Information and Communication Technology
Program Code:	ET208
Course Name:	High Performance Computing (Elective-IV)
Course Code:	2ET2080304T
Pre-requisite Course:	Should have knowledge of Operating System, Computer Organization and Architecture

Course Objective:

1. Understand High Performance Computing (HPC) system architectures and various computational models.
2. Learn basics of CUDA programming.
3. Apply parallel execution models and methodologies for parallel programming and parallel applications development.
4. Design and implement compute intensive applications on HPC platform.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme(Marks)								Total(Marks)
					Theory(Marks)				Practical(Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	3	-	-	3	24	60	16	40	-	-	-	-	100

Subject Contents:

Sr. No	Topic	Total Hours	Weight (%)
1	Parallel Programming & Computing - Introduction Era of Computing, Parallel Computing, Multiprocessors and Multicomputer Architectures, Scalar VS Vector Processing, Multivector and Superscalar Machines, Pipelined Processors, SIMD Computers, Conditions of parallelism, Program flow mechanisms, Types of Parallelism – ILP, PLP, LLP, Program Partitioning and scheduling.	06	15
2	Introduction to High Performance Computing Scalable Parallel Computer Architectures, towards low-cost computing, Network of Workstations project by Berkeley, Cluster Computing Architecture, Components, Cluster Middleware and SSI, Need of Resource Management and Scheduling, Programming Environments	06	15
3	Introduction to Cloud Computing Defining Clouds, Cloud Providers, Consuming Cloud Services, Cloud Models – IaaS, PaaS, SaaS, Inside the cloud, Administering cloud services, Technical interface, Cloud resources	03	05
4	Cluster Computing Clustering Models, Clustering Architectures, Clustering Architectures key factors, types of clusters, Mission critical Vs Business Critical Applications, Fault Detection and Masking Algorithms, Check pointing, Heartbeats, Watchdog Timers, Fault recovery through Failover and Failback Concepts	08	20
5	High Speed Networks & Message Passing Introduction to High-Speed Networks, Lightweight Messaging Systems, Xpress Transport Protocol, Software RAID and Parallel File systems, Load Balancing Over Networks – Algorithms and Applications, Job Scheduling approaches and Resource Management in Cluster	08	25

6	CUDA Programming Need of CUDA, CUDA architecture for parallel processing, Working of CUDA Parallelism Model, Applications of CUDA, Advantages of CUDA, Limitations of CUDA, Introduction to CUDA-C, Parallel programming in CUDA-C, Thread Cooperation and Execution Efficiency, Constants memory and events, memory management, CUDA C on multiple GPUs, Hashing and Natural Parallelism, Scheduling and Work Distribution, Atomics, Barriers and Progress, Transactional Memory	08	20
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Text Books:

1. High Performance Cluster Computing, Volume 1, Architecture and Systems, RajkumarBuyya, Pearson Education.
2. Berman, Fox and Hey, Grid Computing – Making the Global Infrastructure a Reality, Wiley India.
3. Hurwitz, Bllor, Kaufman, Halper, Cloud Computing for Dummies, Wiley India.
4. Georg Hager and Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press.

Reference Books:

1. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill International Editions

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	To Knowledge the overview and analyze the performance metrics of high performance computing.	2 Understanding
CLO2	To comprehend the various High Performance Computing Paradigms and Job Management Systems.	2 Understanding 3 Applying
CLO3	To design and develop various applications with CUDA.	2 Understanding 3 Applying
CLO4	To analyze the benchmarks of High Performance Computing	3 Applying, 2 Understanding
CLO5	To demonstrate the various emerging trends of high performance computing	2 Understanding,
CLO6	To apply high performance computing concepts in problem solving	3 Applying

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	H	M	M	L							L		H	M	M	M
CLO2	H	M	M	L	M					L			H	M		M
CLO3	H	M	M	L							L		H	M	M	H
CLO4	M	L	L		H					L			M	M	M	M
CLO5	H	M	M										M		M	M
CLO6	M	L	L		H					L			M	M	M	M

H: High, M: Medium, L: Low