

# GUJARAT TECHNOLOGICAL UNIVERSITY

**Subject Name:Advanced Parallel Processing**  
**Subject Code:3725503**

## Semester II

**Type of course:** ME - Computer Engineering (HIGH PERFORMANCE COMPUTING [HPC])

**Prerequisite:**

1. Computer Architecture
2. Compiler Design

**Rationale:** NA

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	2#	0	4	70	30	30	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment;

**Content:**

Sr. No.	Content	Total Hrs	% Weightage
1	Parallel Processing Concepts: Physical Organization of Parallel Platform, Threads and Processes, Multi-processing OS, Data and flow dependence, Race conditions, Synchronization and communication fundamentals, concurrency control, Parallel I/O, General concepts	4	8
2	Processors and Multi-Core Architectures: Processors types CISC, RISC, EPIC, VLIW, pipelining etc., Software and hardware multithreading – SMT and CMP architectures – Design issues – Case studies – Intel Multi-core architecture – SUN CMP architecture – IBM cell architecture, Data-Parallel and Data-Flow Systems Connection MachineCM5, Vector processing, Super-scalar, In-order execution, Instruction-Level Parallelism etc., FMA, 32 and 64 bit types, ISA.	4	8
3	Memory and Cache: Introduction, Distributed and shared memory architectures, NUMA, latency, bandwidth, Types of Cache, hierarchy, Cache Line and False Sharing, Cache coherency, Optimizations of Cache Performance	4	8
4	Performance Metrics and scalability analysis: Basic Principles - Sources of inefficiency Metrics: Execution time, speedup, etc. , Throughput vs. Latency, Scalability, Performance analysis	4	8
5	Programming Models, Parallel Algorithms Design : Decomposition Techniques: Data parallelism, Functional parallelism, Divide and Conquer etc., Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Granularity of parallelism, Case Studies	4	10
6	Optimizations: Importance of Code optimization, Compiler optimization	4	10

	techniques , Explicit optimizations		
7	Fault Tolerance of applications: Check-pointing at system level and application level, Programming Using the Message Passing Paradigm: Principles of Message-Passing Programming, MPI: The Message Passing Interface, Advance MPI	4	10
8	Shared Memory Parallel Programming: Why Threads? , The POSIX Threads, OpenMP, Domain Decomposition	4	8

**Course Outcome:**

After learning the course the students should be able to:

1. Explain design issues related to parallel programming and operating system support for parallel computing
2. Design and implement various Parallel Processing Architectures
3. Analysis the performance of parallel Processing
4. Develop programming Models
5. Demonstrate the medium scale Parallel Programs

**Review Presentation (RP):** The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website