GUJARAT TECHNOLOGICAL UNIVERSITY

Subject Name: High Performance Computing Solution & Applications
Subject Code: 3725502

Semester II

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

Prerequisite:

1. Infrastructure management & virtualization
2. research

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	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	Application porting, execution and scalability analysis: Compiler flags, vectorization, memory alignment of data, porting of application on Linux Measurement of Application execution time and memory consumption with small, medium and large datasets, Scalability analysis and identification of performance bottlenecks, Profiling of applications to find opportunities for performance optimization, Addition of directives, Restructuring of code for performance optimization, Communication optimization through configuration of MPI calls of the underlying MPI implementation, Partitioning applications for heterogeneous resources, Use of existing libraries, tools, and frameworks	7	15
2	Bioinformatics and Molecular Dynamics: Basics of bio-informatics and Molecular Dynamics, Sequence Search: e.g. MPI-BLAST, Sequence Alignment: e.g. ClustalW-MPI, Sequence Assembly: e.g. ABySS, Molecular Dynamics: e.g. GROMACS , Scientific data visualization and analytics: Integration of simulation, data visualization and analytics on HPC	8	15
3	HPC Performance Measurement: Computational Complexity Performance Measures of Parallel Algorithms: Power-Aware Computing and Communication Power-aware Processing Techniques, Power-aware Memory Design, Power-aware Interconnect Design , Software Power Management, Granularity and Partitioning, Locality: temporal/spatial/stream/kernel.	9	20
4	Case Studies (Scientific & Engineering Domains) Study and optimization of computational performance of applications Climatology: Basics of computational atmospheric and ocean sciences,	9	20

	Numerical Weather Prediction: e.g. WRF, Oceanography: e.g. MOM, ROMS, Climate: e.g. CFS		

Course Outcome:

After learning the course the students should be able to:

1. Demonstrate the basic structure and operation of a high performance Computing
2. Discuss in detail the operation of multi-processor instruction
3. Use the concepts of bioinformatics and molecular dynamics
4. Analyse the complexity an performance of HPC
5. Work in scientific and engineering domains related to high performance computing

List of Experiments: (with Open Ended Problems)

1. Application porting, execution and scalability analysis:
2. Bioinformatics and Molecular Dynamics:
3. HPC Performance Measurement:
4. Performance Measures of Parallel Algorithms:
5. Case Studies (Scientific & Engineering Domains)

Study and optimization of computational performance of applications Climatology: Basics of computational atmospheric and ocean sciences, Numerical Weather Prediction: e.g. WRF, Oceanography: e.g. MOM, ROMS, Climate: e.g. CFS

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