Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous Institute Affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
CEL922	PG Laboratory –IV (High Performance Computing Laboratory)	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		ESE				Total
				Practical		Oral		
		40		-		20		60

Pre-requisite Course Codes		CE44 CE45 CE62 CE922(High Performance Computing)
At the end of successful completion of the course, students will be able to		
Course Outcomes	CO1	Understand the different parallel computing approaches and platforms to achieve High Performance Computing.
	CO2	Determine the communication pattern and network technology for High Performance Computing
	CO3	Design High Performance Computing System using MPI and OpenMP.
	CO4	Perform heterogeneous Computing using GPGPU and OpenCL.

Exp. No.	Experiment Details	Ref.	Marks
1	**First OpenMP program:** The aim of this lab is to develop our first OpenMP program and write some non-trivial OpenMP programs. We will use a few OpenMP constructs and functions that are in fact very powerful for parallelising most C programs. Although we will use further constructs in the future labs and also in the project. You can compile openmp programs by using the compiler flag `gcc -fopenmp file.c`		**05**
2	**High performance computation of Pi**	1,2,3	**05**
3	**How to access the cluster:** We have set up a HPC cluster for this unit and you need to do the programming projects on the cluster. You can also write your lab code on the cluster. The cluster should be accessible both on and off campus.		**05**
4	**Project 1: Parallelization of column-wise matrix collisions** M is a data matrix of n rows and k columns where, Mi represents ith row-vector and Mj represents jth column-vector as the figure below. Each row-vector is of size k and each column-vector is of size n. Mij represents a data element from row i and column j. The value of each data element Mij lies between 0 and 1. Assume that there is no missing value in this n x k matrix M.		**10**

5	**How to run MPI code on the cluster**		**05**
6	**Project -2: A combined MPI and OpenMP implementation of Parallelization of column-wise matrix collisions:** This project is a continuation from the first project. The aim of the project is to implement the program from the first project into a combined MPI-OpenMP framework. This is quite a common apparoach for exploiting both coarse and fine grain parallelism in programs. A problem is partitioned coarsely at the top level and finely within each individual part. The coarse level partitioning is done using MPI and the finer level partitioning is usually done on a multi-core machine or on a Graphics Processing Unit (GPU). The aim of the project is to partition the matrix into smaller parts and distribute these parts to different computers by using MPI. The computation on each part would now occur within the individual nodes using the cores available on those nodes. The coding in the project will be minimal; it is the case quite often that parallelizing a piece of sequential code requires only small but well thought out modifications.		**10**
		Total Marks	**40**

References:

[1] Kai Hwang, Naresh Jotwani, "*Advanced Computer Architecture: Parallelism, Scalability, Programmability*", Mcgraw-Hill Education, SECOND Edition, 2008.

[2] Ananth Grama, "*Introduction to Parallel Computing*", Addison Wesley, SECOND Edition, 2003.

[3] Rajkumar Buyya, "*High Performance Cluster Computing: Architectures and Systems Volume 1*", Prentice Hall PTR, FIRST Edition, 1993.

[4] Michael J. Quinn, "*Parallel Programming in C with MPI and OpenMP*", McGraw HIll, FIRST Edition, 2003

[5] Benedict Gaster, Lee Howes, David R. Kaeli, Perhaad Mistry, Dana Schaa, "*Heterogeneous Computing with OpenCL*", Morgan Kaufmann, FIRST Edition, 2011