Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2022 – 2023

COURSE HANDOUT (PART II)

Date: 29.08.2022

In addition to Part I (General Handout for all courses appended to the timetable) this handout gives further details regarding the course.

Course No : **CS F422**
Course Title : **Parallel Computing**
Instructor-in-charge : **Dr. Apurba Das**

1. Scope and Objectives of the Course:

Parallel computing architectures have emerged as alternative to high performance computing using powerful single processor machines. Sequential algorithms i.e., algorithms designed for a single processor machine, do not harness the full potential of a parallel machine and hence the need to device new parallel algorithms. Parallel algorithms are highly architecture dependent. Moreover, for a given problem, some parallel architecture is better suited than others. Therefore, it is necessary to study parallel architectures and techniques for designing efficient parallel algorithms.

The main objectives of this course are to give the students exposure to

- Models of parallel computers; Interconnection networks, basic communication operations
- Introduction to parallel algorithms; Parallel programming paradigms; issues in implementing algorithms on parallel computers
- Parallel programming with message passing interface; Performance analysis
- Scalability analysis; Basic design techniques for parallel algorithms
- Parallel algorithms for selected applications like sorting, searching and merging, matrix algebra, graphs.

2. Text Book:

T1: *"Introduction to Parallel Computing"*, Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Second Edition, Pearson Education, 2011.

3. Reference Books:

R1. M.J. Quinn, "Parallel Computing: Theory & Practice'', McGraw Hill Inc. 2nd Edition, Reprint 2017.
R2. M.J. Quinn, "Parallel Programming in C with MPI & OPENMP", Jaico Books, 2004. (Reprint 2017).
R3. Kai Hwang and Faye A Briggs, "Computer Architecture and Parallel Processing", Tata Mc Graw Hill Edition, 2012.
R4. Peterson, "Introduction to Parallel Computing – A Practical Guide with Examples in C", Oxford University Press, 2008.
R5. Peter S Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann Publishers, 2018.

4. Course Plan:

Lecture	Learning Objectives	Topics to be covered	Chapter in the Text

No.			Book
1	Introducing Parallel Algorithms, studying algorithms, minimizing number of processors.	Introduction to parallel processing and parallel processing terminology	**R1** Sec. 1.1,1.2 & 1.3, **T1** Chapter 1
2,3		Contrast between Data Parallelism & Control Parallelism	**R1** Sec. 1.3 & 1.4
4-6		Parallel Programming Platforms	**T1** Sec. 2.1 – 2.3.
7		Physical Organization of parallel computer	**T1** Sec. 2.4
8,9		PRAM algorithms, (parallel reduction, prefix sums, list ranking etc.)	**R1** Sec. 2.3
10		PRAM Sorting Algorithms	Class Notes
11-12		Routing in parallel computer	**T1** Sec. 2.5-2.6
13-15	Studying different organizations, mappings between them, data decomposition and	Processor-Processor mapping & mapping techniques	**T1** Sec. 2.7
16-18		Decomposition Techniques and Task Mapping	**T1** Sec. 3.1,3.2, 3.3
19-20	Performance metrics for parallel systems	Performance metrics for parallel system	**T1** Sec. 5.1, 5.2
21-22		Iso-efficiency function & scalability issues	**T1** Sec. 5.3, 5.4
23-24		Other scalability metrics	**T1** Sec. 5.5, 5.6
25-26	Studying & Analyzing parallel versions of standard sequential algorithms on different processor organizations	Simple parallel algorithms on mesh and hypercube	**R1** Chapter 6 **R2, R3**
27-30		Parallel Matrix Algorithms: Matrix Multiplication, Solving System of Linear Equations	**T1** Chapter 8 **R4**
31-35		Sorting Algorithms on mesh and hypercube	**T1** Chapter 9
36-38		Parallel Graph Algorithms: Prim's MST algorithm (parallelization), Dijkstra's shortest path algorithm (parallelization) etc.	**T1** Sec. 10.1–10.4 **R5**
39-40	Recent Advances in Parallel Computing	High performance parallel computing – Case Study	Recent research publications

5. Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Mid Sem Test	1 hr 30 min	30%	02/11 9.00 - 10.30AM	Closed Book
Quizes (Two)		10%	TBA	Closed Book
Assignments (Take Home)		10%	TBA	Open Book
Term Project		10%	TBA	Open Book
Comprehensive Exam	3 hrs	40%	22/12 FN	Closed Book

Note: For the Assignments/Term Projects (Take Home), exposure to basic programming would be useful.
Note: At least 40% of the evaluation component will considered for Midterm Evaluation.

6. Chamber Consultation Hour: To be announced in the class

7. Notices: Notices regarding the course will be put up on the CSIS notice board and in CMS.

8. **Makeup Policy:** No makeup exam allowed without prior permission.

9. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

INSTRUCTOR-IN-CHARGE