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DHANALAKSHMI SRINIVASAN
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COURSE PLAN

Subject code: CS6801	**Branch/Year/Sem/Section: B.E CSE/IV/VIII**
Subject Name: MULTICORE ARCHITECTURE AND PROGRAMMING	**Batch:2016-2020**
Staff Name: Mrs.K.LALITHA,	**Academic year:2019-2020**

COURSE OBJECTIVE

- Understand the challenges in parallel and multi-threaded programming
- Learn about the various parallel programming paradigms, and solutions.

TEXT BOOK:

T1. 1. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan-Kauffman/Elsevier, 2011. 2. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris", Pearson, 2011

REFERENCES:

R1 Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2003.

R2. Shameem Akhter and Jason Roberts, "Multi-core Programming", Intel Press, 2006.

WEB RESOURCES

W1: http://www.mobot.org/jwcross/spm/ Information on Scanning probe microscopy RAPID http://www.idahotech.com/rapid/index.html .
W2 https://www.scribd.com/document/392401530/Mg6088-Spm-Rejinpaul-Iq-April-May-2017
W3: https://www.manaresults.co.in/jntuh/download.php?subcode=117HP

TEACHING METHODOLOGIES:

- BB - BLACK BOARD
- VIDEO - VIDEO TUTORIAL
- PPT - POWER POINT PRESENTATION

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CS6801 - MULTI-CORE ARCHITECTURES AND PROGRAMMING L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the challenges in parallel and multi-threaded programming
- Learn about the various parallel programming paradigms, and solutions.

UNIT- I MULTI-CORE PROCESSORS 9

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence - Performance Issues – Parallel program design.

UNIT -II PARALLEL PROGRAM CHALLENGES 9

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

UNIT III- SHARED MEMORY PROGRAMMING WITH OpenMP 9

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs - Library functions – Handling Data and Functional Parallelism – Handling Loops - Performance Considerations.

UNIT IV- DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation 79

UNIT V -PARALLEL PROGRAM DEVELOPMENT 9

Case studies - n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

Course plan:

Topic No	Topic Name	Books For reference	Page No	Teaching Methodology	No of periods required	Cumulative periods
UNIT I - MULTI-CORE PROCESSORS (9)						
1.	Hardware, Processes and Threads, Single core to Multi-core architectures. Motivation for Multicore Processors	T1	15-29	BB	1	1
2.	Modifications to Von Neumann Model - Instruction level parallelism, Multithreading	T1	15-29	BB	1	2
3.	Parallel Hardware - SIMD, MIMD	T1	29-46	BB	1	3
4.	Interconnection networks	T1	35-42	BB	1	4
5.	Cache Coherence	T1	43-46	BB	1	5
6.	Symmetric and Distributed Shared Memory Architectures	T1	205-236	BB	1	6
7.	Performance Metrics and Analysis. Parallel Program Design	T1	58-70	BB	1	7
8.	Developing Parallel Program - examples and tools (Writing and Running examples).	T1	70	BB	1	8
9.	Parallel softwares	T1	47-56	BB	1	9
LEARNING OUTCOME: **At the end of unit , the students will be able to** • Understand the concept of multicore process. • To analyze Parallel softwares.						
UNIT II - PARALLEL PROGRAM CHALLENGES (9)						
10.	Performance - Definition, Role of Compilers, Identifying Parallelism	T2	60-83	BB	1	10

11.	Identifying Parallelism, Parallelization Patterns	T2	85-109	BB	1	11
12.	Synchronization and data sharing - Data races (tools to detect data	T2	121-126	BB	1	12
13.	Synchronization primitives (Mutexes, spin locks, semaphores).	T2	126-128	BB	1	13
14.	Synchronization primitives (Readers-Writers Locks, barriers).	T2	129-131	BB	1	14
15.	Deadlocks and live locks.	T2	132	BB	1	15
16.	Communication between threads (condition variables, signals)	T2	133-137	BB	1	16
17.	Communication between threads (message queues and pipes)	T2	138-139	BB	1	17
18.	Communication through the network stack, Storing thread private data	T2	139-141	BB	1	18

LEARNING OUTCOME:20

At the end of unit , the students will be able to

- Understand the concept of Synchronization and data sharing.
- Gain the knowledge about Communication between threads.

UNIT III - SHARED MEMORY PROGRAMMING WITH OpenMP (9)						
19.	OpenMP - Introduction, Execution Model, Compiling and Running OpenMP	T1	209-216	BB	1	19
20.	Memory Model	T1	209-216	BB	1	20
21.	Scope of Variables, Reduction Clause	T1	259-263	BB	1	21
22.	OpenMP Directives - Parallel for directive. Sample Program	T1	224-231	BB	1	22
23.	Work-sharing Constructs - Examples	T4	151-161	BB	1	23
24.	Library functions - Examples	T4	162-163	BB	1	24
25.	Handling Data and Functional Parallelism	T3	421-430	BB	1	25

26.	Handling Loops - Parallelizing loops, Scheduling loops	T2	256-269	BB	1	26
27.	Performance Considerations	T3	417-420	BB	1	27

LEARNING OUTCOME:

At the end of unit , the students will be able to

- Understand the objectives of OpenMP.
- Analyze Work-sharing Constructs.

UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI (9)

28.	MPI - Introduction. MPI program compilation and execution.	T1	83-86	BB	1	28
29.	MPI constructs – libraries MPI Communicators, SPMD programs	T1	86-93	BB	1	29
30	MPI send and receive	T1	145-148	BB	1	30
31	Point-to-point communication, Analysis	T1	145-152	BB	1	31
32	Collective communication - MPI_Reduce, MPI-Allreduce	T1	101-113	BB	1	32
33	Collective communication - Scatter and gather. Point to point Vs Collective	T1	101-113	BB	1	33
34	MPI derived data types	T1	116-119	BB	1	34
35	Performance evaluation - Timings, Scalability, Speed up and Efficiency.	T1	119-126	BB	1	35
36	Parallel Algorithms in MPI	T1	127-136	BB	1	36

LEARNING OUTCOME:35

At the end of unit , the students will be able to

- Understand the concept of MPI.
- Known about MPI derived data types
- Get the knowledge about Parallel Algorithms in MPI

UNIT V PARALLEL PROGRAM DEVELOPMENT (9)

37	Case study: n-Body solvers - Serial programs Parallelizing n-Body Solvers	T1	271-297	BB	1	37

38	Parallelizing using basic/reduced solvers in openMP	T1	280-289	BB	1	38
39	Parallelizing using basic/reduced solvers in MPI	T1	290-297	BB	1	39
40	Case study: Tree Search Recursive and non-recursive depth first search	T1	299-327	BB	1	40
41	Serial implementation of Tree Search and Performance	T1	299-306	BB	1	41
42	Parallelizing Tree Search	T1	306-315	BB	1	42
43	OpenMP and MPI implementations :	T1	316-318	BB	1	43
44	Implementation of Tree Search using MPI.	T1	319-327	BB	1	44
45	OpenMP and MPI Comparison	T1	288,297, 317	BB	1	45

LEARNING OUTCOME:

At the end of unit , the students will be able to

- Known about Parallelizing n-Body Solvers
- Get the knowledge about Implementation of Tree Search using MPI**.**

CONTINUES INTERNAL ASSESSMENT DETAILS

ASSESMENT NUMBER	**I**	**II**	**MODEL**
TOPIC NO.(UNIT)	1-18 (1st & 2nd units)	19-36 (3rd & 4th units)	1-45 (units 1-5)

ASSIGNMENT DETAILS

ASSIGNMENT NUMBER	**I**	**II**	**III**
TOPIC NUMBER FOR REFERENCE	1-18 (1st & 2nd units)	19-36 (3rd & 4th units)	1-45 (units 1-5)
DEAD LINE	06-01-2010	10-02-2020	02-03-2020

ASSIGNMENT NUMBER	DESCRIPTIVE QUESTIONS/TOPIC (Minimum of 8 Pages)
I	Step wise project planning, COCOMO II A
II	Critical path (CRM) method , Earned Value Analysis
III	Best methods of staff selection

PREPARED BY **VERIFIED BY**

Mrs.K.LALITHA, ASP/CSE **HOD/CSE**

APPROVED BY

PRINCIPAL