MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

COURSE PLAN

Department	:	Computer Science and Engineering
Course Name & code	:	HIGH PERFORMANCE COMPUTING SYSTEMS & CSE 5154
Semester & branch	:	FIRST & M TECH [CSE]
Name of the faculty	:	DR. N. GOPALAKRISHNA KINI

No of contact hours/week:

L	T	P	C
36	12	0	4

Course Outcomes (COs)

	At the end of this course, the student should be able to:	No. of Contact Hours	Marks
CO1:	Analyse the structure of parallel computers.	19	38
CO2:	Develop and analyse the parallel algorithm for a given parallel computer.	4	8
CO3:	Write MPI programs using point-to-point and collective communication primitives.	7	16
CO4:	Solve parallel programming tasks using OpenCL.	12	24
CO5:	Analyze thread and memory organization in CUDA and writing kernel programs.	6	14
	Total	48	100

Assessment Plan

Components	Assignments	Sessional Tests	End Semester/ Make-up Examination
Duration	20 to 30 minutes	60 minutes	180 minutes
Weightage	20 % (4 X 5 marks)	30 % (2 X 15 Marks)	50 % (1 X 50 Marks)
Typology of Questions	Understanding/ Comprehension; Application; Analysis; Synthesis; Evaluation	Knowledge/ Recall; Understanding/ Comprehension; Application	Understanding/ Comprehension; Application; Analysis; Synthesis; Evaluation
Pattern	Answer one randomly selected question from the problem sheet (Students can refer their class notes)	MCQ: 10 questions (0.5 marks) Short Answers: 5 questions (2 marks)	Answer all 5 full questions of 10 marks each. Each question may have 2 to 3 parts of 3/4/5/6/7 marks
Schedule	4, 7, 10, and 13th week of academic calendar	Calendared activity	Calendared activity
Topics Covered	Quiz 1 (L 1-7 & T 1-2) **(CO3-CO4)** Quiz 2 (L **8-14** & T 3-4) **(CO4)** Quiz 3 (L 15-22 & T 5-7) **(CO1 & CO5)** Quiz 4 (L 23-32 & T 8-10) **(CO1)**	Test 1 (L 1-16 & T 1-5) **(CO3 & CO4)** Test 2 (L 17-27 & T_{b3-b4}) **(CO5 & CO1)**	Comprehensive examination covering full syllabus. Students are expected to answer all questions **(CO1-5)**

Lesson Plan

L. No.	Topics	Course Outcome Addressed
L0	INTRODUCTION TO THE COURSE	CO
L1	MESSAGE PASSING PROGRAMMING: Introduction, Message passing model, MPI basic data types and functions	CO3
L2	Point-to-point communication, Blocking and nonblocking communication	CO3
L3	Standard send-receive, Synchronous send-receive, Buffered send-receive, Collective communication, Benchmarking parallel performance	CO3
T1	Tutorial 1 on MPI programming	CO3
L4	MPI error handling functions, Problems on basic mathematical functions	CO3
L5	Matrix manipulations, Sort algorithms	CO3
L6	OpenCL ARCHITECTURE: OpenCL standard, OpenCL specification, Kernels and openCL execution models	CO4
T2	Tutorial 2 on MPI programming	CO4
L7	Platform Model, Host/Device Interaction, Execution environment, Contexts, Command Queues	CO4

L8	Memory Objects, Program Object and Kernel Object, Program layout	CO4
L9	Memory model, Writing Kernels	CO4
T3	Tutorial 3 on OpenCL rogram	CO4
L10	Basic OpenCL EXAMPLES: OpenCL APIs	CO4
L11	Hello World program in OpenCL	CO4
L12	Other OpenCL APIs in detail	CO4
T4	Tutorial 4 on OpenCL programs	CO4
L13	Work-item and work-group	CO4
L14	Convolution	CO4
L15	CUDA PROGRAMMING: CUDA programming model	CO5
T5	Tutorial 5 on OpenCL programs	CO4
L16	CUDA tools	CO5
L17	CUDA Libraries and CUDA Programming	CO5
L18	CUDA Libraries and CUDA Programming (Contd..), Comparison of Open CL and CUDA performance	CO5
T6	Tutorial 6 on Complex CUDA programs	CO5
L19	INTRODUCTION TO PARALLEL COMPUTERS: Introduction to Parallel Computing, Need for Parallel Computing, Parallel processing	CO1
L20	Programmatic levels of parallel processing, Parallel processing mechanisms, Parallel Computer Structures	CO1
L21	Parallel Architectural Classification Schemes, Handler's classification	CO1
T7	Tutorial 7 on Parallel computer Classification	CO1
L22	Feng's classification, Applications of parallel processing	CO1
L23	PIPELINING: Linear and non-linear pipelining principles	CO1
L24	Classification of pipeline processor	CO1
T8	Tutorial 8 on Applications on Parallel Processing, Pipelining	CO1
L25	Nonlinear pipelining	CO1
L26	General Pipelines and Reservation tables, Problems on pipelining	CO1
L27	SYNCHRONOUS PARALLEL PROCESSING: SIMD Computer Organization	CO1
T9	Tutorial 9 on Pipelined computers, Data routing mechanisms	CO1
L28	Masking and Data routing mechanisms	CO1
L29	Inter-PE Communications, SIMD interconnection networks	CO1

L30	THREAD LEVEL PARALLELISM AND MULTIPROCESSORS: Introduction, Processor characteristics for multiprocessing	CO1
T10	Tutorial 10 on SIMD interconnection Networks, multiprocessing, Memory architecture	CO1
L31	Centralized Shared Memory Architecture	CO1
L32	Performance of Symmetric Shared Memory Multiprocessor	CO1
L33	Distributed Shared Memory, Interconnection Networks	CO1
T11	Tutorial 11 on MIMD, Interconnection Networks	CO1
L34	ELEMENTARY PARALLEL ALGORITHMS: Hypercube SIMD model	CO2
L35	Shuffle-exchange SIMD model	CO2
L36	2D mesh SIMD model	CO2
T12	Tutorial 12 on Parallel Algorithms	CO2
L/T	Click or tap here to enter text.	

References:

1. Kai Hwang, Faye A. Briggs, Computer Architecture and Parallel Processing, Tata McGraw-Hill India, 2012.
2. John L. Hennessy David A. Patterson Computer Architecture: A Quantitative Approach (5e), 2014.
3. Michael J Quinn, Parallel Computing: Theory and Practice, (2e), Tata McGraw Hill, 2002.
4. Michael J. Quinn, Parallel Programming in C with MPI and OpenMP, McGraw Hill, 2003.
5. Benedict R. Gaster, Lee Howes, David R, Perhaad Mistry, Dana Schaa, Heterogeneous Computing with OpenCL, Morgan Kaufmann, 2012.
6. David B. Kirk, Wen-mei W. Hwu, Pragramming Massively Parallel Processors,A Hands-on Approach, (2e),Elsevier, 2012.
7. Click or tap here to enter text.

Submitted by: **DR. N. GOPALAKRISHNA KINI**

(Signature of the faculty)

Date: 26-07-2019

Approved by: DR. ASHALATHA NAYAK

(Signature of HOD)

Date: 27-07-2019

FACULTY MEMBERS TEACHING THE COURSE (IF MULTIPLE SECTIONS EXIST):

FACULTY	SECTION	FACULTY	SECTION
DR. N. GOPALAKRISHNA KINI			

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