

MAE267 Parallel Computations in Fluid/Thermal Sciences
Fall 2015 Schedule

CLASS	DAY-DATE	LEC DIS	TOPICS	ASSIGNMENT. (read before class)	DUE HW
1	TR-9/24	L	Introduction , Overview of Course, Engineering problem types that must consider parallel computing	HW1, Chap. 1-4 Chapman	
		L	Examples of parallel simulations, parallel computer systems, tutorial on how to log in to hpc1 and compile		
2	T-9/29	L	Fortran 95/03 for engineering programs, structure of statements and programs, assignment statements, intrinsic functions, I/O, branches and loops		
3	TR-10/1	L	Fortran 95/03 for engineering programs, I/O, arrays, procedures, functions	Chap. 5-9 Chapman	
		L,D	Programming Workshop, Algorithms		
4	T-10/6	L	Fortran 95/03 for engineering programs, data-types, pointers, memory allocation	HW2, Chaps. 1 and 2 Grama et al.	HW1
		D	Project-1 : The Heat Conduction Poisson Problem, HW1 discussion	Project-1	
5	TR-10/8	L	Parallel Computer Architectures : SIMD, MIMD, SMPs, distributed-memory, Beowulf clusters, inter-connections		
		D	Programming Workshop, Single-Block Code, Numerical Techniques for 2 nd Difference Operators, Different Algorithms		
6	T-10/13	L	MPI : Distributed memory programming, message passing interface, basic routines, send, receive, buffering, non-blocking	HW3	HW2
		D	Programming Workshop, Algorithms, HW2 discussion		
7	TR-10/15	L	Data Structures for Parallel Computing : multi-block structured, unstructured, hybrid, mesh refinement, implicit and explicit algorithms	Chap. 4-6 Gropp et al.	Project-1
		D	Programming Workshop, Project-1 discussion	Project-2	
8	T-10/20	L	Computer Programming : Importance of Single Processor Performance and Possible Parallel Programming Models	Chap. 1-3 Gropp et al. and Chap. 6 Grama et al.	
		D	Project-2 : Establishing a data structure for the multi-block Heat Conduction Problem		
9	TR-10/22	L	MPI : Distributed memory programming, message passing interface, basic communication	HW4, Chap. 6 Grama et al.	HW3
		D	Programming Workshop, Algorithms, HW3 discussion		
10	T-10/27	L	MPI : Distributed memory programming, Advanced programming using MPI, derived datatypes, advanced routines	Chaps. 3, 4, and 10 Grama et al., Project-3	Project-2
		D	Programming Workshop, Parallel Algorithms, Project-3		

11	TR-10/29	L	Domain Decomposition: types of decomposition		HW4
		D	Project-3 Discussion: The multi-block, serial Heat Conduction Poisson Solver, Project-2 Discussion		
12	T-11/3	L	Domain Decomposition: static graph partitioning, bisection, Metis, ParMetis, Chaco, dynamic decomposition	Chap. 5 Grama et al. HW5 (reading)	
		D	Programming Workshop, Parallel Algorithms, Decomposition Techniques		
13	TR-11/5	L	Data Structures for Decomposed Domains: streamlining parallel PDE/ODE solvers for parallel computing. Performance Performance: Parallel Performance Models and Analysis, Amdahl's law	HW6 (reading)	Project-3
		D	Project 4: A Data Structure for a Parallel Heat Conduction Solver, Programming Workshop, Parallel Algorithms	Project-4	
14	T-11/10	L	Performance: Multi-Processor Performance, bandwidth, latency, speedup, hypercubes	Chap. 7 Grama et al.	
		D	Project-4 Discussion	HW7 (reading)	
15	TR-11/12	L	Shared Memory Parallel Computing: OpenMP, compiler options	Chap. 9 and 11 Grama et al.	
		D	Project-5: Distributed/Shared Parallel Computing of the Heat Conduction Poisson Problem	Project-5	
16	T-11/17	L	OpenMP Constructs: examples, when to use shared-memory vs distributed memory parallel		Project-4
		D	Project-4 and Project-5 Discussion		
17	TR-11/19	L	Accelerators: Graphical Processing Units (GPUs): GPGPU, GPU architecture, CUDA programming, OpenACC	HW8 (reading) CUDA programming	
		D	Project-5 and GPU computing discussion		
	T-11/24		Accelerators: Intel Xeon-Phi, vector processors, OpenMP		
	TR-11/26		Holiday - Thanksgiving		
18	T-12/1	L	Direct Matrix Methods: dense linear algebra solvers, BLAS and LINPACK	HW9 (reading), Chap. 8 and 13 Grama et al.	
		D	Programming Workshop		
19	TR-12/3	L	Parallel Scientific Libraries: LAPACK, SCALAPACK libraries		
		L,D	MPI Communicators for Multi-Disciplinary Applications, Programming Workshop, Project-5 discussion		Project-5

Books:

“Introduction to Fortran 90/95,” by Stephen J. Chapman, First Edition, WCB-McGraw-Hill, 1998 or

“Introduction to Fortran 95/2003 for Scientists & Engineers”, by Stephen J. Chapman,

“Using MPI, Portable Parallel Programming with the Message-Passing Interface,” William Gropp, Ewing Lusk, and Anthony Skjellum, Second Edition, MIT Press, 1999.

“Introduction to Parallel Computing,” by Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, Second Edition, Addison Wesley Publishing, 2003