

Rutgers University, Department of Electrical and Computer Engineering
ABET COURSE SYLLABUS
COURSE: 14:332:451

Course Catalog Description:	14:332:451 – Intro. to Parallel & Distributed Programming (3) Parallel and distributed architectures, Fundamentals of parallel/distributed data-structures, algorithms, programming paradigms, Introduction parallel/distributed application development using current technologies
Pre-Requisite Courses:	14:332:331, 351
Co-Requisite Courses:	None
Pre-Requisite by Topic:	<ol style="list-style-type: none">1. Computer architecture2. Programming Methodology3. Data Structures4. Algorithms5. Operating Systems
Textbook & Materials:	B. Wilkinson and M. Allen, <i>Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers</i> , 2nd Ed., Prentice Hall, 2005.
References:	Hariri and Parashar (Ed.), <i>Tools and Environments for Parallel & Distributed Computing</i> , John Wiley, 2004.
Overall Educational Objective:	To introduce the fundamentals of parallel and distributed programming and application development.
Course Learning Outcomes:	<p>A student who successfully fulfills the course requirements will have demonstrated:</p> <ol style="list-style-type: none">1. An understanding of the fundamentals of parallel and distributed computing including parallel/distributed architectures and paradigms.2. An understanding of key parallel/distributed algorithms and technologies.3. An ability to develop and execute basic parallel and distributed application using basic programming models and tools.4. An understanding of performance issues in parallel/distributed computing and an ability to make appropriate design trade-offs during application developed.5. The ability to apply parallel/distributed computing for problem solving.

How Course Outcomes are Assessed:
HW Problems & Quizzes (30 %)
Two Mid-Term Exams (40 %)

Final Project (Teams of 2) (30 %)

N = none S = Supportive H = highly related

Outcome	Level	Proficiency assessed by
(a) an ability to apply knowledge of Mathematics, science, and engineering	H	HW Problems, Project
(b) an ability to design and conduct experiments and interpret data	H	HW Problems, Project
(c) an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	S	Project
(d) an ability to function as part of a multi-disciplinary team	H	Project
(e) an ability to identify, formulate, and solve ECE problems	H	HW Problems, Exams
(f) an understanding of professional and ethical responsibility	N	
(g) an ability to communicate in written and oral form	S	HW Problems, Project
(h) the broad education necessary to understand the impact of electrical and computer engineering solutions in a global, economic, environmental, and societal context	N	
(i) a recognition of the need for, and an ability to engage in life-long learning	S	Home-work, discussions during lectures
(j) a knowledge of contemporary issues	N	
(k) an ability to use the techniques, skills, and modern engineering tools necessary for electrical and computer engineering practice	H	HW Problems, Project, Exams
Basic disciplines in Electrical Engineering	N	
Depth in Electrical Engineering	N	
Basic disciplines in Computer Engineering	H	HW Problems, Project, Exams
Depth in Computer Engineering	H	HW Problems, Project, Exams
Laboratory equipment and software tools	S	HW Problems, Project
Variety of instruction formats	S	Lecture, office hour discussions

Topics Covered week by week:

- Week 1:** Introduction to Parallel and Distributed Programming (definitions, taxonomies, trends).
- Week 2:** Parallel Computing Architectures, Paradigms, Issues, & Technologies (architectures, topologies organizations)
- Week 3:** Parallel Programming using Message Passing - I (basics of message passing, MPI)
- Week 4:** Parallel Programming Using Message Passing – II (performance, programming paradigms, applications)
- Week 5:** Parallel Programming Using Message Passing – III (embarrassingly parallel computing, partitioning and divide and conquer algorithms, pipelining techniques)
- Week 6:** Parallel Programming Using Message Passing – IV (synchronous and asynchronous parallel computations, load-balancing, termination detection)
- Week 7:** Parallel Programming Using Message Passing – V (algorithms and applications)
- Week 8:** Parallel Programming Using Shared Memory I (basics of shared memory programming, memory coherence, race conditions and deadlock detection, synchronization)
- Week 9:** Parallel Programming Using Shared Memory II (multithreaded programming, OpenMP, HPF, pthreads, Java threads)
- Week 10:** Introduction to Distributed Programming (architectures, programming models)
- Week 11:** Distributed Programming Issues/Algorithms (fundamental issues and concepts - synchronization, mutual exclusion, termination detection, clocks, event ordering, locking)
- Week 12:** Distributed Computing Tools & Technologies I (CORBA, JavaRMI)
- Week 13:** Distributed Computing Tools & Technologies II (Web Services, shared spaces)
- Week 14:** Parallel and Distributed Computing – Trends and Visions (Grids Computing, P2P Computing, Autonomic Computing)
- Week 15:** Review
- Week 16:** Final Examination

Computer Usage: Current parallel/distributed programming technologies (e.g., MPI, Threads, CORBA, JavaRMI, Web Services, etc.) on networked systems.

Laboratory Experiences: The course will consist of multiple programming assignments and a final project that will consist of building and evaluating parallel/distributed applications using current technologies and networked-systems.

Design Experiences: "Hands-on" course with programming assignments and a final project.

Independent Learning Experiences: 1. Home-Work, 2. Term Paper, 3. Testing (Quizzes, Exams)

Contribution to the Professional Component:

(a) College-level mathematics and basic sciences: 0 credit hours

(b) Engineering Topics (Science and/or Design): 3.0 credit hours

(c) General Education: 0 credit hours

Total credits: 3

Prepared by: M. Parashar

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