

ABET COURSE SYLLABUS**ECSE 4690: Experimental and Simulation Techniques for Networking**

Course Catalog Description:	This senior-level laboratory course teaches tools and techniques used in the design and analysis of computer networks and protocols such as simulation, animation, visualization, experiment design, trace collection/analysis, protocol development on Linux, and modular router development platforms (eg: Linux-based "Click" and Intel IXA platform). Each tool is developed in a networking protocol context such as TCP reliable transport, TCP congestion control, routing protocols (RIP, OSPF, BGP), network management and 802.11 wireless networks. Fall term annually. 3 credit hours.	
Pre-Requisite Courses:	ECSE-2660	
Co-Requisite Courses:	ECSE-4670	
Prerequisites by Topic:	<ol style="list-style-type: none"> 1. Elementary networking concepts: layering, packet-switching. 2. Basic computer systems and architecture concepts: memory, I/O, CPU, tradeoffs 3. Basic probability concepts: axioms, independence, pdf, moments. 	
Textbook: (and/or other required material)	Raj Jain: The Art of Computer Systems Performance Analysis, John Wiley, 1991, ISBN: 0471503363, 1st Edition	
References:	Jorg Leiberherr, Magda El Zarki, Mastering Networks : An Internet Lab Manual (Paperback), Addison-Wesley, ISBN: 0201781344, 1st edition.	
Course Coordinator:	Shivkumar Kalyanaraman, Associate Professor, Electrical, Computer and Systems Engineering	
Overall Educational Objective:	Learn to use a variety of tools (measurement, simulation, animation, experiment) for design and analysis of computer/network systems. Understand practical and real-world design issues through hands-on experience in a lab/studio setting.	
Course Learning Outcomes:	<ol style="list-style-type: none"> 1. Understand networking protocols through hands-on experimentation 2. Perform performance analysis of networking protocols with a variety of tools (simulation, analysis, experiments). 3. Understand how to choose the right set of experiments (experiment design) and build empirical regression models of system performance. 4. Apply multiple tools in the context of a specific non-trivial networking design problem. 	
How Course Outcomes are Assessed:	Lab Work/Reports	{50 %}
	Term Project:	{20 %}
	Mid-Term and Final Exam:	{30 %}

Relation to EE/CSE/EPE Outcomes

N = none
M = moderate
H = high

Outcome	Level	Demonstrate Proficiency
	N, M, H	e.g. Exams, projects, HW
Mathematics, science and engineering	M	Exams, projects
Basic disciplines in Electrical Engineering	N	
Depth in Electrical Engineering	N	
Basic disciplines in Computer & Sys. Eng.	H	Exams, projects
Depth in Computer and Systems Eng.	H	Exams, projects

Electromagnetics, electromechanics, power semiconductors	N	
Power system behavior	N	
Electrical energy conversion	N	
Conduct experiments and interpret data	H	Lab projects
Identify, formulate and solve problems	M	Term project
Design a system, component or process	M	Term project
Communicate in written and oral form	M	Term project
Function as part of a multi-disciplinary team	N	
Preparation for life-long learning	M	projects
Ethical issues; safety, health, public welfare	N	
Humanities and social sciences	N	
Laboratory equipment and software tools	H	projects
Variety of instruction formats	M	

**Topics Covered:
(number of hours or classes for each)**

1. Simulation and animation tools: black-box testing of protocols (4 hours)
2. Simulation development: prototype ideas in simulation (12 hours)
3. Systematic Tracing, Graphing, Profiling of results (4 hours)
4. Review of applied probability, statistics (4 hours)
5. Systematic design of a *set of experiments* to maximize information learnt (4 hours)
6. Linux-based protocol development: (8 hours)
7. Analyze Internet Measurement Data Archives (4 hours)
8. Development on modular platforms: Click router (4 hours)
9. **Term project:** Choose a networking design problem and use a mix of relevant tools to incrementally design, prototype, test and validate solutions. Present results to class and write a final report. (16 hours)

Computer Usage:

Linux-based PC systems with simulation and other packages installed in a large lab setting.

Laboratory Experiences:

1. Scripts and internet probe experiments
2. Network simulation development, analysis of results
3. Design of experiments for networking protocol analysis
4. Linux kernel modifications of networking code
5. Analysis of internet routing tables
6. Term project involving multiple tools

Design Experiences:

1. Experiment and simulation design for networking
2. Term project to design and analyze internet protocols

Independent Learning Experiences:

1. Term project involving a networking design problem and multiple performance analysis tools.

Class/Lab Schedule:

JEC 4201, Wednesdays 3-7 pm

**Contribution to the
Professional Component:**

- (a) College-level mathematics and basic sciences: 0 credit hours
 (b) Engineering Topics (Science and/or Design): 3 credit hours
 (c) General Education: 0 credit hours

Prepared by:	Shivkumar Kalyanaraman
Date:	7 th April 2006