EE 381K-13 Communication Networks: Analysis and Design **SPRING 2005**

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Overview: The objective of the course is to develop mathematical models that allow the study of admission control, congestion control and pricing mechanisms used in emerging high-speed and wireless networks. A primary focus of the course would be the Internet. Thus, most of the models developed in this course will be motivated by emerging protocols and services in the Internet such as RED, ECN and DiffServ.

Pre-requisites: The pre-requisites for this course are EE 381J (Graduate Random Processes) or equivalent and undergraduate background in networking.

Textbook: Data Networks, by Bertsekas and Gallager, Prentice Hall, 1992. Handouts will also be provided for many topics.

Class Hours: Class will be held on **Mondays and Wednesdays, 9:30 - 10:45 AM** in **ENS 109**. Office hours will be held after class on Mondays and Wednesdays between 10:45 -4 12:00 PM in ENS 437.

Course Policy: Attendance is expected. You are responsible for material covered in the reading assignments (even if not covered in class) as well as material covered in class that is not in the book.

You may discuss homework problems with other students, but you are not allowed to copy from others. University disciplinary procedures will be invoked if any form of cheating is detected. Course and instructor evaluations will occur the last day of class.

"The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities." For more information, contact the Office of the Dean of Students at 471-6259, 471-4241 TDD or the College of Engineering Director of Students with Disabilities at 471-4321.

Grading:

(i) Class Participation: 5%

(ii) Homework: 10%

(iii) Midterm Exam 1: 25% (February 28)

(iv) Midterm Exam 2: 25% (April 11)

(v) Final Exam: 35%

Syllabus

1. **Overview and Taxonomy of Communication Networks:** circuit switched networks, virtual-circuit switched networks and Internet congestion control
2. **Elements of Queueing Theory:** Markov Chains, Poisson process, M/M/1 queue, M/G/1 queue, multi-server queues, Erlang-B formula, Little's law, P-K formula
3. **Internet Congestion Control:** optimization based framework, relation to TCP, linearized stability with round-trip delay, Active Queue Management (AQM): Tail drop, RED
4. **Stochastic and Deterministic Traffic Modeling:** leaky bucket regulator and worst-case provisioning, network calculus, Chernoff bound and zero-buffer multiplexing, large buffer behavior and effective bandwidth
5. **Stochastic dynamic programming:** Markov decision processes, and applications to optimal control of communication networks
6. **Loss Networks:** (if time permits) resource allocation for circuit switching (trunk reservation), reduced load approximation, Kaufman-Roberts recursion

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References

1. A. Kumar, D. Manjunath and J. Kuri, "Communication Networking : An Analytical Approach," Morgan Kaufmann Series in Networking Edition, 2004.
2. R. W. Wolff, "Stochastic Modeling and the Theory of Queues," Prentice Hall, 1989.
3. S. Ross, "Stochastic Processes," Wiley, 1995.
4. J. Walrand and P. Varaiya, "High Performance Communication Networks," Morgan Kaufman 1996.
5. J. Bucklew, "Large Deviation Techniques In Decision, Simulation And Estimation," Wiley, New York, NY, 1990.