EE 381K-5 Advanced Telecommunication Networks (16280) **FALL 2005**

Instructor: Sanjay Shakkottai **shakkott@ece.utexas.edu**

Overview: The objective of the course is to develop mathematical models that allow the study of scheduling and resource allocation problems for wired and wireless networks. Topics covered will include opportunistic scheduling, quality of service and fairness for networks with time-varying channels. In addition, we will also study related topics such as switch scheduling for Internet routers.

The course will develop mathematical techniques for asymptotic analysis of communication networks. This includes fluid limits, diffusion limits, large deviations and stochastic differential equations.

Pre-requisites: You will need to have a good background in Probability and Random Processes (EE 381J or equivalent), as well as a graduate course on communication networks Analysis (EE 381K-13 or equivalent). In addition, a course in real analysis (M 365C or equivalent) will be highly desirable. This is an ADVANCED course, which for the most part will be taken by second or third year students in ECE, OR or CS.

Textbook: Handouts and notes will be provided. In addition, we will discuss various papers on suitable topics. A suggested reference book is B. Oksendal, "Stochastic Differential Equations," Springer.

Format: Homework (25%), paper presentations (25%) and a final project (50%). The details will be discussed in the first class.

Class Hours: Class will be held on **Mondays and Wednesdays, 9:30 - 11:00 pm** in **ENS 116**.

List of papers covered in class:

1. A. N. Rybko and A. L. Stolyar, "Ergodicity of stochastic processes describing the operation of open queueing networks," *Problems of Information Transmission*, vol. 28, 1992.

2. S. H. Lu and P. R. Kumar, "Distributed Scheduling Based on Due Dates and Buffer Priorities," *IEEE Transactions on Automatic Control*, pp. 1406-1416, Dec. 1991.

3. M. I. Reiman, "Some Diffusion Approximations with State Space Collapse," Modelling and Performance Evaluation Methodology, F. Baccelli and G. Fayolle (editors), Springer-Verlag, 1984, pp. 209-240.

4. L. Tassiulas and A. Ephremides, "Dynamic server allocation to parallel queues with randomly varying connectivity," *IEEE Transactions on Information Theory*, Vol. 39, No. 2, pp. 466-478, March 1993.

5. M. Andrews, K. Kumaran, K. Ramanan, A. L. Stolyar, R. Vijayakumar, P. Whiting, "Scheduling in a Queueing System with Asynchronously Varying Service Rates," *Probability in the Engineering and Informational Sciences*, 2004, Vol.18, pp. 191-217.

6. S. C. Borst, "User-level performance of channel-aware scheduling algorithms in wireless data networks," *Proceedings of IEEE Infocom*, 2003.

7. T. Bonald, S. C. Borst, A. Proutiere, "How mobility impacts the flow-level performance of wireless data networks," *Proceedings of IEEE Infocom*, 2004.

8. G. de Veciana and J. Walrand, "Effective bandwidths: Call admission, traffic policing and filtering for ATM networks," Queueing Systems, No. 20, 37-59, 1995.

9. D.D. Botvich and N. G. Duffield, "Large deviations, economies of scale, and the shape of the loss curve in large multiplexers," *Queueing Systems*, 20, 293-320, 1995.

10. F. Kelly, A. Maulloo and D. Tan, "Rate control in communication networks: shadow prices, proportional fairness and stability," *Journal of the Operational Research Society*, vol. 49, pp. 237-252, 1998.

11. G. de Veciana, T.-J. Lee, and T. Konstantopoulos, "Stability and performance analysis of networks supporting elastic services," *IEEE/ACM Transactions on Networking*, vol. 9 No. 1, 2-14, February 2001.

12. J. Dai and B. Prabhakar, "The throughput of data switches with and without speedup," Proceedings of IEEE INFOCOM '00, Tel Aviv, Israel, March 2000, pp. 556-564.