Middle East Technical University

Department of Electrical and Electronics Engineering

Spring 2014

## EE 749

# COMMUNICATION NETWORK ANALYSIS

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| --- | --- | --- | --- |
| Instructor | Office | e-mail | Class Time and place |
| Elif Uysal-Bıyıkoğlu | D 208 | elif@eee.metu.edu.tr | Wed 8:40-11:30 DZ17 |

**Goal of the course**

Networking concepts have become essential to the design of high-performance communication systems, including wired and wireless networks. More broadly, network science is emerging as a field that encompasses the study of network phenomena that occur in diverse settings from the Internet to biological to societal networks such as transportation networks. The goal of this course is to gain working knowledge of a set of **models and tools of network theory** to be able to design and analyze algoritms and understand the behavior of systems containing network concepts.

**Prerequisites:** EE531 or equivalent fluency in basic probabilistic analysis; EE444 or equivalent background on computer networks.

**References**

* Bertsekas and Gallager, *Data Networks* (2nd ed.) (Chapters 3 and 5 will be covered)
* Bruce Hajek, *Communication Network Analysis*, (available for download at <http://www.ifp.illinois.edu/~hajek/Papers/networkanalysis.html>) (To be used as a reference book on theory.)
* W. Stallings, *Data and Computer Communications (8th ed.)*, (To be used as a reference book on technologies.)

**Course Outline**

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| 1. Review of Markov Chain Theory (1 week)    1. Discrete-Time Markov Chains    2. Detailed Balance Equations    3. Continuous-Time Markov Chains    4. Drift and Stability 2. Delay Models in Data Networks (~4 weeks)    1. Multiplexing Traffic on a Communication Link    2. Little’s Theorem    3. Applications of Little’s Theorem    4. M/M/m, M/M/m/m, and other Markov Systems with Poisson Arrivals    5. Multidimensional Markov Chains and applications in Circuit Switching, blocking probabilities    6. Truncation    7. The M/G/1 System, Pollaczek-Kinchin formula    8. M/G/1 Queues with Vacations    9. Reservations and Polling    10. Priority Queuing    11. Networks of Transmission lines | * 1. Burke’s theorem and reversibility   2. Networks of Queues and Jackson’s Theorem  1. Routing (~3 Weeks)    1. Flooding and Broadcasting    2. Shortest Path Routing    3. Spanning Tree Routing    4. Undirected graphs    5. The Bellman-Ford algorithm    6. Dijkstra’s algorithm    7. Distributed Bellman-Ford algorithm    8. Examples: OSPF, Leach, Heed    9. The wireless broadcast problem    10. The wireless multicast problem    11. Flow models, optimal routing and topological design 2. Selected Papers from Recent Literature (~4 weeks)    1. Some topics are:   Throughput-optimal scheduling and routing  Networks with heterogeneous energy supplies  (The list of papers will be announced.) |

**Tentative Grading Policy**

4 homework assignments (10%)

2 Midterm Examinations: 60 % ( 30 % + 30 %)

Class attendance and presentation of an assigned paper: 30 %