Course Number: ECE 642  
Prerequisites: Courses on Random Processes (ECE 528), and Computer Network Architecture & Protocols (ECE 542), or Permission of Instructor  
Instructor: Bijan Jabbari, Professor  
Semester: Fall 2015

Lecture Time: Tuesdays 4:30-7:10 pm  
Location: Nguyen Engineering Building 1107  
Office: Eng. Bldg. Room 3232  
Office phone: 993-1618  
Email: bjabbari@gmu.edu  
Office hours: Thursday 3:00- 4:30 pm, other times by appointment

Teaching Assistant: TBD  
Administrative Assistant: TBD

Course Objective  
This course will cover the analytical and design aspects of packet switched and forwarding networks (e.g., IP-based networks), routing (intra-domain and Inter-domain), and path computation algorithms. The course starts with a treatment of a single node (e.g., a router, or a switch) as a queueing system (state-dependent queues, imbedded Markov chains, etc.) and continues with modeling of virtual channels through a network of queues. Also, topics such as admission control modeling, performance evaluation of local and wide area computer networks (e.g., LANs, IP/Internet, MPLS Traffic Engineering), and analysis of random access techniques are covered.

Note to those who are taking the course  
This is a graduate-level (MS/PhD) course in performance modeling of contemporary communications networks. In addition to analytical models, students are taught how to develop simulation models for queueing systems as well as other stochastic processes using MATLAB. More specifically, the typical solutions for projects assigned in the class will be made available using MATLAB programming. There will be five to six weekly or bi-weekly projects to help students learn how to use MATLAB for simulation of single queue, network of queues and applications. These projects complement the analytical modeling technique and have considerable pedagogic value in helping students understand random processes, performance evaluation of a node or a network. Projects also represent real life examples of network design. Note that while use of MATLAB is encouraged for carrying out the simulation projects, students may use other general-purpose programming languages such as C, C++ or JAVA.
Tentative course outline

- Background and review of basic concepts in computer networks, review of transform techniques, random processes, and point processes.
- Introduction to queueing theory, M/M/1 queue, state probabilities, expected queue size and delay, Little’s formula.
- Analysis of state-dependent queues, Markov chains, M/M/C queues and variations, priority queues.
- Imbedded Markov chain: the M/G/1 queue.
- The imbedded Markov chain analysis of time-division multiplexing.
- Networks of queues, open queueing systems, closed queueing systems, independence assumption.
- Congestion control and modeling using closed queueing networks.
- Solutions to closed queueing networks: Norton model, Buzzen’s algorithm, and mean value analysis.
- Constraint-based routing, Multi Protocol Label Switching (MPLS), and traffic engineering.
- Statistical multiplexing gain, congestion control and routing in MPLS networks.
- Performance of local and wide area networks incorporating routers.
- Performance analysis of polling and random access techniques.
- Queueing modeling of QoS, weighted fair queueing, or other selected topics as time permits.

Textbook and References

B. Jabbari, lecture notes (will be made available to students through web posting)

Grading:

Student performance will be evaluated by exams, homework and projects/term paper on advanced topics. The percentage of items is given as:

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<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework</td>
<td>5%</td>
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<tr>
<td>Projects/Term Paper</td>
<td>20%</td>
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<tr>
<td>Mid-term Examination</td>
<td>35%</td>
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<tr>
<td>Final Examination</td>
<td>40%</td>
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Both Midterm Exam and Final Exam (Tuesday, December 15) will be in-class and closed-book. Students will be provided with formula sheets to avoid memorization.