

Syllabus for “Design and Analysis of Computer Communication Networks”

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Class Meets:

Day : Thursday
Time : 1400-1700
Where : Dept.of Comp.Eng., Seminar Room

Course Description : This course deals with the design principles and performance modeling of TCP/IP networks. We will focus on (1) mathematical modeling of TCP dynamics, (2) tools and techniques for the performance evaluation of TCP/IP networks, (3) performance concepts and issues for running TCP/IP over wireless, mobile, and satellite networks, (4) congestion-control algorithms in hosts and routers, and (5) high performance implementation of TCP/IP protocol stack.

Course Goals : At the conclusion of this course, the student will have learned the concept and principles of performance of TCP/IP networks. The student will be able to successfully model and analyze a TCP/IP system. The student will be able to design and model a TCP/IP network considering the cases.

Prerequisites : “Computer Networks” in BS or “Network Architectures and Protocols” course in MS or equivalent.

Course Schedule : (Subject to Change)

No	Topic	Duration	Reading Assignment	Projects Due
1	Overview of Computer Communications and Networking; <ul style="list-style-type: none"> ▪ TCP/IP Fundamentals ▪ Background and Review of Fundamentals, 	1 week	Paper 1	
2	Queuing Theory <ul style="list-style-type: none"> ▪ Scope of Queueing Theory, Basic Model and Notation, Little’s Law ▪ Markovian Systems ▪ The M/M/1-Queue ▪ The M/M/m-Queue ▪ The M/M/1/K-Queue 	3 weeks	Paper 2 Paper 3	
3	Active Queue Management in TCP/IP Networks <ul style="list-style-type: none"> ▪ Passive Queue Management ▪ Active Queue Management ▪ Performance Evaluation and Comparison of AQM Schemes 	1 week		
4	Performance Measurement of TCP/IP Networks <ul style="list-style-type: none"> ▪ MeasurementTasks ▪ Popular Measurement Tools (Tcpcap, Netperf, DBS etc.) ▪ Right Tool Selection 	½ week		
5	TCP/IP Network Simulation <ul style="list-style-type: none"> ▪ Systematic Simulation Study ▪ Simulation Types ▪ Simulation Validation and Verification TCP ▪ Some Network Simulators (ns, OPNET, OMNET++) 	½ week		
6	TCP Modeling <ul style="list-style-type: none"> ▪ Mathematical Modeling of TCP ▪ Essentials of TCP Modeling ▪ TCP Models 	1 week		
7	TCP/IP Performance over Wireless Networks <ul style="list-style-type: none"> ▪ Wireless Networks (Cellular, WLAN) Characteristics ▪ TCP Performance Issues over Wireless Links ▪ Improving TCP Performance over Wireless Links ▪ Trends in Wireless Systems and Emerging Networks 	1 week	Paper 4	
8	TCP/IP Performance over Mobile Networks: <ul style="list-style-type: none"> ▪ TCP Performance in Cellular Networks ▪ TCP Performance in Ad Hoc Networks 	1 week	Paper 5	

9	TCP/IP Performance over Satellite Networks <ul style="list-style-type: none"> ▪ Satellite Internet Architectures ▪ Satellite Characteristics (Related with TCP) ▪ Problems with Satellite Communications ▪ TCP Enhancements for Satellite Networks ▪ New Transport Protocols for Satellite Links 	2 weeks	Paper 6 Paper 7	
10	New TCP Standards <ul style="list-style-type: none"> ▪ TCP Reno ▪ TCP NewReno ▪ TCP SACK ▪ TCP Vegas and others ▪ Performance Comparison of TCP Approaches 	1 week	Paper 8	
11	TCP/IP Performance over Asymmetric Networks <ul style="list-style-type: none"> ▪ Types of Network Asymmetry ▪ Impact of Asymmetry on TCP Performance ▪ Improving TCP Performance over Asymmetric Networks 	If there is remaining time		
12	TCP Implementation	If there is remaining time		

Grading : **Mid-term** : 30%
Projects : 40%
Final : 30%

Projects : There will be at least two projects assigned during the semester. All projects must be typed according to IEEE journal typing standard.

Exams : The format of exams will be a combination of multiple choice, fill-in, short answer, or classical questions/answers. The Final Exam does not include all course material; however, knowledge of the material covered during the semester is integrated into exam material.

Required Reading and Reference Material:

Textbook :

- "High Performance TCP/IP Networking; Concepts, Issues, and Solutions". Mahbub Hassan, Raj Jain. Prentice Hall, 2004, ISBN 0-13-064634-2 (US) or ISBN 0-13-127257-8 (Int.Ed.)
- "System Modeling and Analysis: Foundations of System Performance Evaluation, 1/E". Hisashi Kobayashi, Brian L. Mark. Prentice Hall, 2010, ISBN 0-13-034835-X
- "Data Networks, 2nd Ed.". D.P. Bertsekas and R.G. Gallager. Prentice Hall, 1992, ISBN 0-13-200916-1 and is accessible from Dr. Dimitri P. Bertsekas's webpage <http://web.mit.edu/dimitrib/www/datanets.html>
- "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling". R. Jain. Wiley-Interscience, 1991, ISBN 0-47-150336-1
- "Communication Networking, An Analytical Approach". Anurag Kumar, D. Manjunath and Joy Kuri, Elsevier – Morgan Kaufmann, 2004, ISBN 978-0-12-428751-8

Course Notes :

- "A Short Introduction to Queueing Theory". Andreas Willig, Technical University Berlin, 1999. Notes are accessible from Dr. Andreas Willig's webpage <http://www.tkn.tu-berlin.de/~awillig/> and is available at: <http://www.tkn.tu-berlin.de/curricula/ws0203/ue-kn/qt.pdf>
- "Stochastic Performance Evaluation of Computer and Communication Systems – Markov Chains and Single-Station Queueing Systems". Andreas Willig, Technical University Berlin, 2008. Notes are accessible from Dr. Andreas Willig's webpage <http://www.tkn.tu-berlin.de/~awillig/> and is available at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.148.2381&rep=rep1&type=pdf> and <http://www.tkn.tu-berlin.de/curricula/ws0708/vl-stolb/skript-web.pdf>

Supplementary:

- "Computer Networks, 4th Ed.". Andrew S. Tanenbaum, Prentice Hall, 2002, ISBN 0-13-066102-3
 - "Data & Computer Communications, 9th Ed.". William Stallings, Prentice Hall, 2004, ISBN 0-13-100681-9
 - "Computer Networking: A Top-Down Approach, 5th Ed.". James F. Kurose and Keith W. Rose, Addison Wesley, 2010, ISBN 0-13-607967-9.
 - "Networking Concepts and Technology, A Designer's Resource". Deepak Kakadia and Francesco DiMambro, Sun Microsystems, 2004, ISBN 0-13-148207-6
- "Internetworking Technologies Handbook, 4th Ed.", Cisco Systems, Inc., 2010, ISBN 1-58-705119-2. Book is also available online at: http://www.cisco.com/en/US/docs/internetworking/technology/handbook/ito_doc.html