Al-Albayt University
Faculty of Information technology
Department of CS
First Semester, 2008/2009

Course Syllabus

Course Title: **Advance Network**	**Course code:**
Course Level: 3	**Course prerequisite (s) and/or corequisite (s):**
Lecture Time: 2:-5:	**Credit hours:** 3

Academic Staff Specifics

Name	Rank	Office Number and Location	Office Hours	E-mail Address
Dr. Venus Samawi	**Associated professor**		**1-2**	**Drvenus_uni@yahoo.com** **venus@aabu.edu.jo**

Course module description:

This course will covers advanced fundamental design and implementation principles of Internet, key networking issues and their solutions. This course will cover synthesis approach, looking at the network as a whole: identify, study common architectural components, protocol mechanisms, design/implementation principles and trade-offs. Several important topics in depth will be investigated, topics that are *not* covered in an introductory networking course. See the reading materials for addition information on topics covered in the course. . *The students are required to read and review required readings on their own, preferably in advance, including those that are not covered in the lectures.* In addition, additional supplemental reading materials will be provided to the students

Course module objectives:

Course/ module components

- Review of Networking Basics (netwrok)
- Network Architectural, Design, Implementation Principles
- Case studies: IP multicast and anycast
- Multimedia Networking; Overlay and P2P Networks
- Congestion Control, Active Queue Management and Beyond
- Packet Scheduling; QoS Architectures and Mechanisms
- Router Design
- Intra-Domain Routing and Traffic Engineering
- Inter-Domain Routing and BGP; BGP Policy Issues;
- Internet Measurement Basics: Traffic, Performances, etc.
- Routing Measurement, Routing Instability and Improvements
- Network Security and Malware
- 802.11, Wireless Mesh Networks; TCP Performance and IP Mobility
- Internet Architecture Revisited

In addition to the above, the students will be provided with handouts by the lecturer.

Text book:

[kr] Computer Networking: A Top-Down Approach by Kurose & Ross, 3rd Edition, Addison Wesley

Learning outcomes:

Assessment instruments

Allocation of Marks	
Assessment Instruments	**Mark**
Mid Exam	25%
Final examination: 50 marks	50%
Reports, research projects, Quizzes, Home works, Projects	20%
Attendancy	5%
Total	100%

Documentation and academic honesty

Submit your home work covered with a sheet containing your name, number, course title and number, and type and number of the home work (e.g. tutorial, assignment).

Any completed homework must be handed in to my office by 15:00 on the due date. After the deadline "zero" will be awarded. You must keep a duplicate copy of your work because it may be needed while the original is being marked.

For the research report, you are required to write a report similar to a research paper. It should include:

- **Abstract**: It describes the main synopsis of your paper.
- **Introduction**: It provides background information necessary to understand the research and getting readers interested in your subject. The introduction is where you put your problem in context and is likely where the bulk of your sources will appear.
- **Methods (Algorithms and Implementation)**: Describe your methods here. Summarize the algorithms generally, highlight features relevant to your project, and refer readers to your references for further details.
- **Results and Discussion (Benchmarking and Analysis)**: This section is the most important part of your paper. It is here that you demonstrate the work you have accomplished on this project and explain its significance. The quality of your analysis will impact your final grade more than any other component on the paper. You should therefore plan to spend the bulk of your project time not just gathering data, but determining what it ultimately means and deciding how best to showcase these findings.
- **Conclusion**: The conclusion should give your reader the points to "take home" from your paper. It should state clearly what your results demonstrate about the problem you were tackling in the paper. It should also generalize your findings, putting them into a useful context that can be built upon. All generalizations should be supported by your data, however; the discussion should prove these

points, so that when the reader gets to the conclusion, the statements are logical and seem self-evident.

- **Bibliography:** Refer to any reference that you used in your assignment. Citations in the body of the paper should refer to a bibliography at the end of the paper.

• **Protection by Copyright**

1. Coursework, reports, and essays submitted for assessment must be your own work, unless in the case of group projects a joint effort is expected and is indicated as such.
2. Use of quotations or data from the work of others is entirely acceptable, and is often very valuable provided that the source of the quotation or data is given. Failure to provide a source or put quotation marks around material that is taken from elsewhere gives the appearance that the comments are ostensibly your own. When quoting word-for-word from the work of another person quotation marks or indenting (setting the quotation in from the margin) must be used and the source of the quoted material must be acknowledged.
3. Sources of quotations used should be listed in full in a bibliography at the end of your piece of work.

• **Avoiding Plagiarism**.

1. Unacknowledged direct copying from the work of another person, or the close paraphrasing of somebody else's work, is called plagiarism and is a serious offence, equated with cheating in examinations. This applies to copying both from other students' work and from published sources such as books, reports or journal articles.
2. Paraphrasing, when the original statement is still identifiable and has no acknowledgement, is plagiarism. A close paraphrase of another person's work must have an acknowledgement to the source. It is not acceptable for you to put together unacknowledged passages from the same or from different sources linking these together with a few words or sentences of your own and changing a few words from the original text: this is regarded as over-dependence on other sources, which is a form of plagiarism.
3. Direct quotations from an earlier piece of your own work, if not attributed, suggest that your work is original, when in fact it is not. The direct copying of one's own writings qualifies as plagiarism if the fact that the work has been or is to be presented elsewhere is not acknowledged.
4. Plagiarism is a serious offence and will always result in imposition of a penalty. In deciding upon the penalty the Department will take into account factors such as the year of study, the extent and proportion of the work that has been plagiarized, and the apparent intent of the student. The penalties that can be imposed range from a minimum of a zero mark for the work (without allowing resubmission) through caution to disciplinary measures (such as suspension or expulsion).

Course/module academic calendar

week	Basic and support material to be covered	Homework/reports and their due dates
(1)	Class Logistics Networking and TCP/IP Overview lect1-intro.ppt, lect1-logistics.ppt	
(2)	Network Architectural, Design and Implementation Principles;] Case Studies: IP Multicast; IP Anycast lect2-Internet-design.ppt,	

	lect2-1-IP-multicast-anycast.ppt	
(3)	Introduction to Multimedia Networking;lect3-multimedia-networking.ppt	
(4)	Overlay, ESM and i3 P2P Networks Packet Scheduling and QoS Mechanisms; Basic QoS Theory; Internet QoS Architecture: InterServ vs. DiffServ; RSVP. lect4-overlay-i3.ppt, lect5-p2p.ppt	
(5)	Wrap up Internet QoS; Network Congestion Control, Active Queue Management and Beyond	
(6)	Router Design lect8-router-design.ppt	
(7)	Brief Discussion of Network Simulation/Emulation/Experiment Tools lect9-evaluation-tools.ppt	
(8)	Mid term	
(9)	Intra-Domain Routing and Traffic Engineering; lect10-igp-te.ppt	
(10)	Continue discussion on Traffic Engineering (follow last week's slides) Overview of Inter-Domain Routing and BGP;	
(11)	BGP Policy Issues Internet Measurement Basics and Routing Behavior	
(12)	Routing Convergence and Improvements	
(13)	Network Security and Malware	
(14)	Routing and Forwarding in Wireless Mesh and Ad Hoc Networks	
(15)	Revsion	
(16)	**Final Examination**	

Expected workload:

On average students need to spend 2 hours of study and preparation for each 50-minute lecture/tutorial.

Attendance policy:

Absence from lectures and/or tutorials shall not exceed 15%. Students who exceed the 15% limit without a medical or emergency excuse acceptable to and approved by the Dean of the relevant college/faculty shall not be allowed to take the final examination and shall receive a mark of zero for the course. If the excuse is approved by the Dean, the student shall be considered to have withdrawn from the course.

Module references

Books

- *Computer Networks: A Systems Approach*, by Peterson and Davies, 3nd Ed, Morgan Kaufmann
- *An Engineering Approach to Computer Networking* by S. Keshav, Addison Wesley Logman, Inc., 1997.
- *Computer Networks* by A. Tanenbaum, Prentice Hall, 4th ed

Journals and chapters need to be read for each lecture

Internet Architectural, Design and Implementation Principles

- **[Cla88]** D. Clark, "The Design Philosophy of the DARPA Internet Protocols", SIGCOM'88, 106-114, Palo Alto, CA, Sept 1988. [pdf]
- **[Car96]** B. Carpenter, "Architectural Principles of the Internet", RFC 1958, Jun 1996. [.pdf]
- **[SRC84]** J. Saltzer, D. Reed, and D. Clark, "End-to-end Arguments in System Design". ACM Transactions on Computer Systems (TOCS), Vol. 2, No. 4, 1984, pp. 195-206. [pdf]

IP Multicast and Anycast

- Section 4.7 in [KR] "Broadcast and Multicast Routng", or Section 4.4 in [PD] "Multicast".
- [Bh03] S. Bhattacharyya, Ed. "An Overview of Source-Specific Multicast", RFC 3569, 2003. [.pdf]; (see aslo RFC 4607 [.pdf])
- [PMM] C. Partridge, T. Mendez, W. Milliken, "Host Anycast Service", RFC 1546, 1993. [.pdf]

Multimedia Networking, Overlay and Peer-to-Peer Networks, and New Forwarding Modes.

- Sections 7.1-7.5 in [KR] "Multimedia Networking", or Section 7.2 in [PD] "Data Compression" and Section 9.3 in [PD] "Multimedia Applications"
- **[CRSZ01]**, Y. Chu, S. Rao, S. Seshan, H. Zhang, "Enabling Conferencing Applications on the Internet Using an Overlay Multicast Architecture"; In Proc. of SIGCOMM '01. [.pdf]
- [**Ba+03**] H. Balakrishnan et al, "Looking up Data in P2P Systems", In CACM, 2003. [.pdf]
- [**St+02**] I. Stoica, et al, "Internet Indirection Infrastructure," In *Proc. of ACM Sigcomm 2002*. [.pdf]

TCP, Congestion Control, Active Queue Management and Beyond

- **[All99]** M. Allman, V. Paxson, and W. Stevens, "TCP Congestion Control", RFC 2581, 1999. [.pdf]; updated by RFC3390.

- **[FJ93]** S. Floyd and V. Jacobson, "Random Early Detection gateways for Congestion Avoidance" IEEE/ACM Transactions on Networking, 1(4):397-413 August 1993. [.pdf]
- **[KHR02]** D. Katabi, M. Handley, C. Rohr, "Congestion Control for High Bandwidth-Delay Product Networks". In Proc. of SIGCOMM'02 [.pdf]
- [**KHF06**] E. Kohler, M. Handley and S. Floyd, "Designing DCCP: Congestion Control without Reliability". In Proc. of SIGCOMM 2006. [.pdf]

Packet Scheduling and Internet Quality-of-Service

- Sections 7.6-7.9 in [KR] on "Beyond Best-Effort and Internet QoS", or Section 6.5 "Quality of Service" in [PD].
- **[PG93]** R. Parekh, R. Gallager, "A generalized processor sharing approach to flow control in integrated services networks: the single-node case," IEEE/ACM Transactions on Networking, 1993. (Sections 1 and 2 only) [.pdf]
- **[LT+]** J.-E. Le Boudec, P. Thiran, et al, "A Short Tutorial on Network Calculus", Part I [.pdf] and Part II [.pdf]
- **[B+98]** S. Blake et al, "An Architecture for Differentiated Services", RFC 2475, December 1998. [.pdf].
- **[BCS94]** R. Braden, D. Clark & S.Shenker. "Integrated Services in the Internet Architecture: an Overview", RFC 1633, June 1994, [.pdf]
- **[Z+93]** L. Zhang, S. Deering, D. Estrin, S. Shenker, and D. Zappala, "RSVP: A New Resource Reservation Protocol", IEEE Communications Magazine, 31(9):8-18, September 1993. [.pdf]

Router Design

- [**SV99**] V. Srinivasan, G. Varghese, "Fast Address Lookups Using Controlled Prefix Expansion," *ACM Transactions on Computing Systems*, 1999. [.pdf]
- [**GM01**] P. Gupta, N. Mckeown, "Algorithms for Packet Classification" *IEEE Network*, March 2001. [.pdf]
- [**Mc+99**] N. McKeown, A. Mekkittikul, V. Anantharam, J. Walrand. "Achieving 100% Throughput in an Input-Queued Switch", *IEEE Transactions on Communications,* Vol.47, No.8, August 1999. [.pdf]
- **[KS98]** S. Keshav and R. Sharma, "Issues and Trends in Router Design", IEEE Communications Magazine, Vol. 36, No. 5, May 1998, pp. 144-151. [.pdf]

Intra-Domain Routing and Traffic Engineering

- **[Aw99]** D.O. Awduche. "MPLS and Traffic engineering in IP Networks", *IEEE Communications Magazine*, Dec. 1999, pp. 42-47. [.pdf]
- **[FRT02]** B. Fortz, J.Rexford, M. Thorup, "Traffic engineering with Traditional IP Routing Protocols", *IEEE Communications Magazine*, Oct. 2002, pp. 118-124. [.pdf]
- **[WWZ01]** Y. Wang, Z. Wang, L. Zhang, "Internet Traffic Engineering without Full Mesh Overlaying", INFOCOM 2001. [.pdf]
- **[SGD05]** A. Sridharan, R. Guerin and C. Diot, " Achieving Near-Optimal Traffic Engineering Solutions for Current OSPF/IS-IS Networks", *IEEE/ACM Transaction on Networking*, Jan, 2005. [.pdf]

Inter-Domain Routing and BGP Policies

- **[Norton00]** W. B. Norton, "Internet Service Providers and Peering", Draft paper, 2000. [.pdf]
- **[CR]** M. Caesar and J. Rexford, "BGP Routing Policies in ISP Networks", IEEE Network Magazine, special issue on interdomain routing, November/December 2005. [.pdf]
- **[GSW02]** T. G. Griffin, F. B. Shepherd and G. Wilfong, "The Stable Paths Problem and Interdomain Routing", IEEE Transactions on Networking, April 2002. [.pdf]
- **[GR]** L. Gao and J. Rexford, ""Stable Internet Routing without Global Coordination"," ACM SIGMETRICS 2000, also IEEE/ACM Trans. Networking, vol. 9, pp. 681–692, December 2001. [.pdf]

Internet Monitoring and Measurement Basics; Routing Measurement and Routing Behavior

- **[Pa97]** Vern Paxson, "End-to-End Routing Behavior In the Internet", IEEE/ACM Transactions on Networking, Oct 1997. [.pdf]

- **[LABJ00]** C. Labovitz, A. Ahuja, A. Bose and F. Jahanian, "Delayed Internet Routing Convergence", ACM SIGCOM 2000. [.pdf]
- **[AG04]** Aman Shaikh, Albert Greenberg, "OSPF Monitor: Architecture, Design and Deployment Experience,"
  USENIX Symposium on Networked Systems Design and Implementation (NSDI), San Francisco, CA, USA, March 2004. [.pdf]

Routing Convergence and Improvements

- **[I+02]** Gianluca Iannaccone, Chen-nee Chuah, Richard Mortier, Supratik Bhattacharyya, Christophe Diot, "Analysis of link failures in an IP backbone", Proc. of ACM SIGCOMM Internet Measurement Workshop 2002, Marseille, France. [.pdf]
- **[N+07]** Srihari Nelakuditi, Sanghwan Lee, Yinzhe Yu, Zhi-Li Zhang, Chen-Nee Chuan, "**Local Rerouting for Handling Transient Link Failures**", IEEE/ACM Transactions on Networking, [.pdf]
- **[EPIC]** Jaideep Chandrashekar Zhenhai Duan Zhi-Li Zhang Jeff Krasky, "Limiting Path Exploration in BGP ", IEEE INFOCOM 2005. [.pdf]

Internet Security

- **[SPW02]** Stuart Staniford, Vern Paxson and Nicholas Weaver, "How to 0wn the Internet in Your Spare Time" In Proc. 11th USENIX Security Symposium, Aug 2002. [.pdf]
- **[EarlyBird]** Sumeet Singh, Cristian Estan, George Varghese and Stefan Savage, "Automated Worm Fingerprinting", In Proc. of OSDI'04. [.pdf]
- **[XZB05]** Kuai Xu, Zhi-Li Zhang and Supratik Bhattachyrra, "Profiling Internet Backbone Traffic: Behavior Models and Applications," In Proc. of ACM SIGCOMM, Philadelphia, PA, August 2005. [.pdf]

Routing and Forwarding in Wireless Mesh/Ad Hoc Networks

- **[ETX]** Douglas S. J. De Couto and Daniel Aguayo and John Bicket and Robert Morris, "A High-Throughput Path Metric for Multi-Hop Wireless Routing" In Proc. of the 9th ACM International Conference on Mobile Computing and Networking (MobiCom '03), 2003 [.pdf]
- **[ExOR]** Sanjit Biswas and Robert Morris, "Opportunistic Routing in Multi-Hop Wireless Networks", In SIGCOMM, Aug 2005. [.pdf]
- **[BAF]** Srihari Nelakuditi, Sanghwan Lee, Yinzhe Yu, Junling Wang, Zifei Zhong, Guor-Huar Lu, and Zhi-Li Zhang, "Blacklist-Aided Forwarding in Static Multihop Wireless Networks," In the Proceedings of SECON'05, Santa Clara, CA, Sep 2005 [.pdf]
- **[XOR]** Sachin Katti, Hariharan Rahul, Wenjun Hu, Dina Katabi, Muriel Medard and Jon Crowcroft, "XORs in the Air: Practical Wireless Network Coding," In *Proc. of SIGCOMM 2006.*, Sept. 2006, Pisa, Italy. ACM. [.pdf]

Rethinking and Re-Designing the Internet Architectures

- [PST04] L. Peterson, S. Shenker, J. Turner, "Overcoming the Internet Impasse through Virtualization," Proc. HotNets 2004. [.pdf]
- [C+05] D. Clark et al, "Making the World (of Communications) a Different Place," Computer Communications Review 2005 [.pdf]
- [4D] Greenberg el al, "A Clean Slate 4D Approach to Network Control and Management", Computer Communications Review 2005 [.pdf]
- [B+04] Balakrishnan, Lakshminarayanan, Ratnasamy, Shenker, Stoica, and Walfish, "A Layered Naming Architecture for the Internet" In Proc. of ACM SIGCOMM 2004. [.pdf]

Websites
