<div align="right">Spring 2007</div>

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Rivier College
Syllabus
CS575A Advanced Networks

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1. **Course number and title:** CS575A Advanced Networks

2. **Instructor's name:** Dr. Vladimir V. Riabov, Associate Professor; Office: STH-312; Tel: (603) 897-8613;
    E-mail: vriabov@rivier.edu; Web site: http://www.rivier.edu/faculty/vriabov/

3. **Course description:** This course provides the students with a comprehensive understanding of the protocols and technologies of Local and Wide Area Networks (LANs and WANs). Topics include: Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, LAN-switch technologies, Token Ring and Fiber Distributed Data Interface, Fiber channel, Virtual LAN, Asynchronous Transfer Mode LAN and LAN emulation, technologies in building enterprise campus networks using 10/100/1000/10000 Ethernet and ATM switches, Quality of Service support for multimedia enterprise-campus networks, LAN interconnection using bridges, routers, and layer 2/3 switches, wireless LAN technologies and standards, packet-switching networks, frame relay, routing protocols, congestion control and resource allocation, Asynchronous Transfer Mode technologies, Internet, TCP/IP protocols, IPv6, Quality of Service and multimedia support, Packet over SONET, Multiprotocol Label Switching, Voice over IP, Virtual Private Network, higher layer protocols, and network modeling techniques with OPNET software.
    Prerequisite: CS553 Introduction to Networking Technologies.

4. **Course objectives:**

    The sophistication of data communications and computer networks is growing rapidly. New technologies, standards, and systems are emerging each day to meet the requirements of new applications. It is essential for computer engineers and technical professionals to develop a solid foundation as well as state-of-the-art expertise in data communications and computer networks in order to face these challenges.

    This course attempts to provide an overview of the technologies and architecture of Local and Metropolitan Area networks, and encourage students to develop a solid foundation and on-hand experience in these areas. Topics to be covered include data communication networking models, protocols, standards, analog and digital data transmission, transmission media (twisted pair wires, coaxial cables, and fiber optics), broadband technologies, multimedia communications, ATM, LAN systems (Ethernet, CSMA/CD, Token Ring, FDDI, Wireless LANS), switching and routing networks, and virtual LANs.

    Upon completion of this course, the student should learn:
    - Layered network architectures, OSI Reference Model, and TCP/IP protocol suite
    - The Internet Organizations and some RFC Publications
    - Networking Protocol categories (Transmission services, Addressing, Flow and Error Control, Multiplexing, Segmentation and Reassembly, Routing, Multiprotocol Label Switching Encapsulation)
    - Applications (SMTP, FTP, TELNET, HTTP, and others)
    - Analog and Digital Data Transmission Methods
    - Difference between synchronous and asynchronous communications
    - Signal transmission analysis, its strength and delay distortion, bandwidth limitations (Nyquist and Shannon theories), International Reference Alphabet, Fourier concepts
    - Guided transmission media (twisted pair, coaxial cable, optical fiber), wireless transmission technologies (microwave, infrared, radio), and satellite systems
    - Modulation theory and modems
    - Data Communication Interfaces and standards, line configurations (topology, full/half duplex)
    - Data link control principles: Logical Link Control (LLC), Asynchronous Transfer Mode (ATM)
    - Multiplexing techniques (Frequency-Division, Time-Division)
    - Digitization techniques (Pulse Code Modulation), digital transmission technologies (T1 and T3)
    - Broadband technologies (ISDN, ASDN, xDSL, and cable modem)

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- Fiber optic transmission systems and SONET
- Wide-Area Networks (Circuit-Switching, Packet-Switching, Frame Relay, ATM, Broadcast networks topologies, such as bus, ring, and star)
- Routing Strategies and Protocols (OSPF, RIF, RSVP, and BGP)
- Asynchronous Transfer Mode (ATM)
- LAN Technology (BUS, Ring, Star, Wireless, and Bridges)
- LAN Systems (Ethernet, CSMA/CD, Token Ring, FDDI, Fiber Channel, Wireless LANs)
- Internetworking Protocols (IPv4, IPv6, ICMP, IGMP)
- Transport Protocols (TCP, UDP)
- Storage Area Networks
- Network Security (Encryption, Digital Signature, IPSec)
- Networking simulation and modeling techniques with OPNET software.

5. Class Dates and Time: January 16, 2007 – May 1, 2007; Tuesdays: 5:30 PM - 7:30 PM

6. Required textbook:
- William Stallings, <u>Local & Metropolitan Area Networks</u>, 6th edition, Prentice Hall, 2000 (ISBN: 0-13-012939-0) [*required*].
- Kevin Brown and Leann Christianson, <u>OPNET Lab Manual to Accompany Data and Computer Communications (7th edition)</u>, Pearson Prentice Hall, 2005 (ISBN: 0-13-148252-1) [*optional*].

7. Recommended books:
- William Stallings, <u>Data and Computer Communications</u>, 7th edition, Prentice Hall, 2004.
- Andrew S. Tanenbaum, <u>Computer Networks</u>, 4th edition, Prentice-Hall, Inc., 2003.
- Larry L. Peterson and Bruce S. Davie, <u>Computer Networks: A Systems Approach</u>, 3rd edition (2003), Morgan Kaufmann Publishers.
- Behrouz Forouzan, <u>Local Area Networks</u>, 1st edition (2003), McGraw-Hill.
- <u>Handbook of Information Security</u>, Vols. 1-3, edited by H. Bidgoli, John Wiley & Sons, January 2006.
- <u>The Internet Encyclopedia</u>, Vols. 1-3, edited by H. Bidgoli, John Wiley & Sons, Jan. 2004
- Tom Sheldon, <u>McGraw-Hill's Encyclopedia of Networking & Telecommunications</u>, 2nd edition, McGraw-Hill, June 2001.
- A. Dennis, <u>Networking in the Internet Age</u>, 5th edition, Wiley, 2002.
- Bruce S. Davie, Larry L. Peterson, David Clark, <u>Computer Networks: A Systems Approach</u>, 2nd edition (1999), Morgan Kaufmann Publishers.
- Srinivasan Keshav, <u>An Engineering Approach to Computer Networking</u>, 1st edition (1997), Addison-Wesley.
- William Stallings, <u>Wireless Communications and Networks</u>, 1st edition (2001), Prentice Hall.
- Radia Perlman, <u>Interconnections: Bridges, Routers, Switches, and Internetworking Protocols </u>(Addison Wesley Professional Computing Series), 2 edition (October 1999), Addison-Wesley.
- Howard Johnson, <u>Fast Ethernet</u>, Prentice Hall, 1996.
- Kadambi, Crayford, and Kalkunte, <u>Gigabit Ethernet - Migration to High-Bandwidth LANs</u>, 1998.
- Seifert, <u>Gigabit Ethernet</u>, Addison Wesley (1998).
- Palais, <u>Fiber Optical Communications</u>, Prentice Hall (1988).
- Smith, <u>Virtual LANs: Construction, Operation, Utilization</u>, 1997.
- Kyas and Crawford, <u>ATM Networks</u>, Prentice Hall (2002).
- McDyson and Spohn, <u>ATM--Theory and Application</u>, (Signature Edition), McGraw Hill, (1999).
- Handel, Huber, and Schroder, <u>ATM Networks: Concepts, Protocols, Applications</u>, 3rd Edition, 1998.
- Leon-Garcia and Widjaja, <u>Communication Networks: Fundamental Concepts and Key Architectures</u>, McGraw-Hill Professional Publishing, 1999.
- Ata Elahi, <u>Network Communications Technology</u>, 1st edition, Delmar Publishers, 2000.
- D. E. Comer, <u>Internetworking with TCP/IP, Vol. I: Principles, Protocols, and Architecture</u>, 4th edition, Prentice Hall, 2000.
- William Stallings, <u>ISDN and Broadband ISDN with Frame Relay and ATM</u>, 4th edition (1999), Prentice Hall.

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- *Articles* published in IEEE and other Technical Journals.
- *Technical information* and *white papers* published on the Internet.

Partial List of Excellent Reference Sources for Classes and Project Assignments:
- Request For Comments, Network Standards, available from http://www.rfc-editor.org/rfcsearch.html;
- IEEE Communications Magazine (technical journal);
- IEEE Journal on Selected Areas in Communications (technical journal);
- IEEE Network (technical journal);
- IEEE Spectrum (technical journal);
- IEEE Transactions on Communications (technical journal);
- Computer Communications (technical journal);
- Computer Networks and ISDN Systems (technical journal);
- Bell System Technical Journal;
- Lightware, The Journal of Fiber Optics (technical journal);
- Data Communications (trade magazine – O.K. for technical reference);
- Network Magazine (trade magazine -- OK for technical reference)
- Telecommunications (trade magazine – O.K. for technical reference);
- Byte (trade magazine – O.K. for technical reference);
- Embedded Systems (trade magazine – O.K. for technical reference);
- Communications Week (weekly newspaper – NOT for technical reference);
- Network World (weekly newspaper – NOT for technical reference).

8. **Classroom Policies:**

   a) Attendance: The classroom is the heart of the educational experience at Rivier College because it provides, uniquely, a formal setting for the important exchanges among faculty and students. Regular and punctual attendance at all classes, essential for maximum academic achievement, is a major responsibility of Rivier College students. Failure to attend and contribute to the classroom environment significantly and demonstrably reduces the quality of the educational experience for everyone in the classroom. As a result, absences almost always impact the quality of performance.
   As part of its commitment to a quality educational experience for all members of the Rivier community, the College formally requires specific attendance policies to be developed by its professors and reviewed by the Division Head and Academic Dean. Any attendance policy used by an individual professor as a criterion for evaluation must be specified in the course syllabus and presented to students during the first week of classes. These policies can be found in respective course syllabi, and may include reasonable penalties and sanctions for excessive absences.
   In the event of prolonged illness, accident, or similar emergency, it is the responsibility of the student to notify both the professor and the Office of the Academic Dean. Students must remember that it is always their responsibility to make up the work they may have missed during an absence from class. Students are directed to confer with their professors when their absences jeopardize satisfactory progress. Whenever a professor is absent without notification, students are expected to wait fifteen minutes before leaving and to sign an Attendance List, which a class member delivers to the Office of the Academic Dean.
   Instructors are required to record attendance and alert the Registrar when a student fails to attend the equivalent of two weeks of courses (2 absences for a course meeting once a week, 4 absences for a course meeting twice a week, 6 absences for a course meeting three times a week). The student will then be alerted that he/she is in danger of falling under the "Habitual Non-Attendance Policy" (see below).

   Habitual Non-Attendance Policy:
   Habitual non-attendance is defined as an absence in any course (for any reason whatsoever) equating to three full weeks of missed class sessions (3 absences for a course meeting once a week, 6 absences for a course meeting twice a week, 9 absences for a course meeting three times a week).
   It is the responsibility of the student to notify the College of any intention to withdraw from a course or withdraw from the College. The College will attempt to resolve the issue of habitual non-attendance with the student; however, the College reserves the right to withdraw students who are no longer attending classes. Habitual non-attendance in one or more classes may result in administrative withdrawal from the

class or classes affected, withdrawal from the College or, in cases with extenuating circumstances, an administrative leave of absence. In such cases a grade of W of NF will be assigned to the classes affected according to the appropriate date published in the academic calendar.

Students who have attended no class sessions of a course or courses from which they are registered by the end of the drop/add period will be dropped from each class not attended. If a student never attended any courses during the drop/add period, the student will be withdrawn from his/her full schedule of courses.

b) Honesty policy: Plagiarism and cheating are serious breaches of academic honesty. In general, plagiarism is defined as the presentation of someone else's work in whatever form: copyrighted material, notes, film, art work, reports, statistics, bibliographies, and the like, as one's own, and failing to acknowledge the true source. Quoting word-for-word, or almost so, or using the argumentation of another source without acknowledging this dependence also constitutes plagiarism. Cheating is defined as the giving or attempting to give or to receive unauthorized information or assistance during an examination or in completing an assigned project. Submission of a single work for two separate courses without the permission of the instructors involved is also a form of cheating.

If students are unsure whether a specific course of action would constitute plagiarism or cheating, they should consult with their instructor in advance.

Penalties for plagiarism and cheating vary with the degree of the offense and may take the form of the following academic sanctions:
- the grade of F for the work in question;
- the grade of F for the course;
- notification of the department chair and/or Academic Dean of the College of the misconduct of the student;
- recommendations that the student be suspended or dismissed from the College.

c) Project Assignment (individual project): Your assignment is to write a study report *or* a research paper. The purpose of writing the report/paper is for you to gain an in-depth understanding of a particular topic that you are interested, or the technical knowledge that you learned will benefit you for your work or for your career development. It also gives you an opportunity to learn how to do independent research work as well as how to write a technical report/paper.

The potential topics for your report/paper are listed as follows:
- Use Fast and Gigabit Ethernet Technologies to build an Enterprise Network
  (Discuss Fast and Gigabit Ethernet technologies based on a survey of current vendor product information (e.g., Foundry, Cisco, and Extreme), compare their features and capabilities for the support of different applications, and how to use their Fast and Gigabit Ethernet technologies to build an Enterprise network);
- Gigabit Ethernet and 10Gigabit Ethernet Technologies for the integration of LAN/MAN/WAN;
- ATM versus Gigabit Ethernet technologies;
- ATM, QoS, and multimedia applications;
- ATM traffic management and QoS;
- ATM and LAN Emulation;
- Voice over IP (VoIP);
- Wireless LAN & MAN Technologies;
- Fiber Optic Technologies and High-speed LAN/MAN;
- Storage Area Networks;
- Fiber optic technologies and multimedia data communications;
- A topic of your own selection (may be related to your work).

The paper should consist of about 15 typed pages plus illustrations, bibliography, and appendices (if necessary). A minimum of six technical articles and/or books must be used as sources for your paper. At least thirty percent of your reference materials should be technical articles published within two years.

You ***must*** submit your outline and discuss it with me before you start writing the paper or start your project. If you need advice regarding the topic to select, the format of the paper, the contents of the paper, or reference material, you should discuss it with me. Discussing the same with your classmates is also encouraged. The outline discussion process is very important, because, only through this process, I may

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help you to organize your paper, advise you on the contents of the paper, advise you on where to find references, and guide you to the right direction. ***The Project/Paper is due on April 24, 2007***.

d) <u>FOUR homework assignments</u> are scheduled (due January 30, February 20, April 3, and April 17, 2007).

e) <u>FOUR *in-class* labs</u> are scheduled (January 30, February 13, March 20, and April 10, 2007).

9. **Americans With Disabilities Act (Ada):**
   Rivier College wants to provide reasonable accommodations to students with disabilities. To accomplish this goal effectively and to ensure the best use of our resources, timely notice of a disability must be provided to the Office of Special Services for verification and for evaluation of available options. Any student whose disabilities fall within ADA should inform the instructor within the first two weeks of the term of any special needs or equipment necessary to accomplish the requirements for the course. To obtain current information on this procedure, contact the Office of Special Services at telephone extension 8497.

10. **24/7 Blackboard Technical Support:**
    All students have the ability to access Blackboard technical support on a 24/7 basis. Students have many different options for obtaining support, including phone, online technical library, or Live Chat with a customer service representative. The support can be accessed by following this link:
    http://supportcenteronline.com/ics/support/default.asp?deptID=3250

11. **Evaluation Mechanism:**
    Students are required to pass all exams and complete all assignments (four homeworks, four labs, and research project paper). Exams will be based on textbooks, lecture material, and handouts. All exams will be comprehensive, closed book and open notes, and will be conducted online. See "***Project Assignments***" for detailed project assignment requirements. Grades for all exams and assignments will not be determined by curves. Letter grades submitted to the Registrar's Office would be based on the Rivier College Grading system. The conversion from numerical grade to letter grade will be based on the following table:

Letter Grade	Honor Points	Numerical Grade
A	4.0	94-100
AB	3.5	90-93
B	3.0	84-89
BC	2.5	80-83
C	2.0	73-79
F	0.0	Below 73

The grade is made up of your performance on your homeworks, labs, project, midterm and final exams. Approximate weightings are as follows:

Homeworks	16%
Labs	20%
Midterm Exam	20%
Final Exam	20%
Project	24%

12. **Due Dates:**

Homeworks #1-4 due:	January 30, February 20, April 3, and April 17, 2007
In-class Labs #1-4:	January 30, February 13, March 20, and April 10, 2007
Project Proposal:	February 13, 2007
Midterm Exam:	February 27, 2007
Project due:	April 24, 2007
Final Exam:	May 1, 2007

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13. **Topic Outline:**

SESSION	TOPIC	READING	HOMEWORKS
1 (01/16)	Introduction to LAN Concepts Layered Local Network Architecture Transmission Media, Data Communications	Ch. 1 Ch. 2	
2 (01/23)	Protocols and the TCP/IP Suite. LAN Topologies. OPNET Introductory Lab00	Ch. 3 Ch. 4, OPNET	
3 (01/30)	Network Protocol Reference Model MAC and LLC Layers. In-class Lab01 Bridges and Routers	Ch. 5 Ch. 5, OPNET Ch. 5	**Homework #1 due** **In-class Lab01 due**
4 (02/06)	LLC Services and Protocols	Ch. 6	
5 (02/13)	Ethernet LANs, CSMA/CD. In-class Lab02 10-Mbps, 1000-Mbps, and Gigabit Ethernet	Ch. 7, OPNET	**In-class Lab02 due** **[PROJECT PROPOSAL DUE]**
6 (02/20)	Token Ring Medium Access Control IEEE 802.5, FDDI Mid-term Exam Preparation	Ch. 8 Ch. 8	**Homework #2 due**
7 (02/27)	**[MID-TERM EXAM]**		**[MID-TERM EXAM]**
8 (03/06)	**NO CLASSES (SPRING VACATION)**		
9 (03/13)	Fibre Channel, Storage Area Networks Framing Protocol	Ch. 9, Handouts Ch. 9	
10 (03/20)	Wireless LAN Architecture & Standards Infrared and Spread Spectrum LANs; Wireless MANs; In-class Lab03	Ch. 10, Handouts Ch. 10 OPNET	**In-class Lab03 due**
11 (03/27)	Asynchronous Transfer Mode (ATM) LANs ATM LAN Architecture and Emulation	Ch. 11, Handouts	
12 (04/03)	Ethernet LANs Bridge, Routing with Bridges, Spanning Tree Routing Traffic Classes and Quality of Services	Ch. 12	**Homework #3 due**
13 (04/10)	Internetworking and Routers: IPv4, IPv6 In-class Lab04	Ch. 13, Handouts OPNET	**In-class Lab04 due**
14 (04/17)	Network Management; MPLS; VoIP; Simple Network Management Protocol (SNMP)	Ch. 14 Ch. 14, Handouts	**Homework #4 due**
15 (04/24)	LAN Performance *Final Exam Preparation* **[PROJECT DUE]**	Ch. 15	**[PROJECT DUE]** **[PROJECT DUE]**
16 (05/01)	**[FINAL EXAM]**		**[FINAL EXAM]**