DeVRY UNIVERSITY

Course Syllabus

Spring 2007

Course Title: Advanced Network Engineering w/Lab
Course Number: **CET442**
Credit/Contact Hour: 4-2-5
Course Dependency: Prerequisite(s): CET381
Co-requisite(s): (none)

Instructor: Tom Wheeler
Email: twheeler@kc.devry.edu
Web Site: http://faculty.kc.devry.edu/twheeler/
Voice Mail: 816.941.0430 x5211
Office Hours: Monday 11-11:50 am; Thursday 12-12:50pm; Friday 12-12:50pm

Course Description

This course examines protocols, internetworking, design issues and security considerations related to Wide Area Networks (WANs) and Local Area Networks (LANs) used in data and multimedia applications

Textbooks and Materials

Textbook/s Title:	**Ed**	**Author**
COMPUTER NETWORKS	Curr	Tannenbaum

Terminal Course Objectives (TCOs):

Following are the objectives for this course. Individual faculty, based upon their experience and expertise may add to these objectives to meet local campus needs. Any such additions will be communicated to the class. While the instruction remains focused in helping students, accomplishing these objectives is a shared responsibility of students and faculty. The outcomes of this course will depend upon the motivation and capabilities of the students, sufficient time allocation for studying, and the effectiveness of that effort.

DeVry University is committed to the continual improvement of its curriculum and instruction and to meet the needs of students and employers in a rapidly changing global economy. Students, faculty, and the university must all be actively involved to accomplish these objectives, as well as the objectives of this particular course.

Every class is to some extent a unique interactive experience, which may cause some variance within the stated objectives, in either content or level. Individual faculty, based on their experience and expertise, are encouraged to add objectives, as they deem appropriate, and to communicate these directly to the class. The outcomes of the course will depend on the design of the course, the quality of instruction, and the motivation and capabilities of the students, including time available for studying and the effectiveness of the effort.

1...Given a multiple-subnet network with the number of hosts on each subnet specified, create a subnet design that uses Variable Length Subnet Masking (VLSM) to minimize the number of wasted IP addresses. Specify the routing protocol that will support your design.

2. Given a limited pool of public IP addresses owned by a company for Internet access, implement a solution whereby two class C private networks attached to the company's router can access the Internet via a serial connection from the router to the ISP. Discuss how Network Address Translation (NAT) provides security and maximizes the use of limited public IP addresses. Also discuss the limitations and overhead associated with NAT.

2. Given an enterprise network utilizing a hierarchical 3-layer model (Access, Distribution and Core layers), implement an IP addressing scheme that will allow for all routes below each distribution layer router to be aggregated (or summarized) as a single route to the core layer. Use EIGRP or OSPF as your routing protocol and specify the IOS commands required on the distribution layer router to summarize all access layer routes to the core router.

3...Given a hierarchical 2-layer network such as School district with Regional Hubs serving up to 12 schools each and the floor plans for one of the schools, create a case study for the design of the network for one of the schools. Requirements include WAN and LAN IP addressing schemes, selection of the access routers and LAN switches, Horizontal and Vertical wiring details, traffic control using ACLs and selection and placement of servers (administrative, application, DHCP, E-mail, DNS, curriculum, etc.).

4...Given various internetwork topologies, determine the most effective IP routing method to use. Consider static, RIP (version 1 or 2), IGRP, EIGRP and OSPF. Justify your decision with an analysis of the capabilities and limitations of each IP routing methodology.

5...Given a large Wired and Wireless Network, create an Authentication plan designed to increase network security. Include internal users as well as remote users. Justify your choices in terms of security, cost and management overhead.

6...Given a large Wired and Wireless Network, analyze the possible internal or external attacks on the network. Describe the attack scenarios and how to deal with each type of attack. Include Denial of Service attacks, Spoofing, Replays, TCP Session Hijacking and Attacks on Encrypted Data (such as passwords).

7...Given a large network with Wireless Access Points (WAPs), implement a security plan that allows authorized wireless users to access network resources while preventing unauthorized access. The plan should include authentication of wireless users and encryption of data.

8...Given a large Network with Internet Access, design high-level security plan that will provide protection against Internet intrusions. The plan should include a Fire Wall with a DMZ for publicly accessible servers, Private addressing for the internal users and Access Control Lists to filter traffic.

9...Given an Internetwork of Local Area Networks (LANs) connected to each other via a public medium (such as the Internet), create a detailed plan for the creation of a Virtual Private Network (VPN) to protect the transfer of data from corruption and unauthorized access. Include provisions for secure remote access of employee to the company network.

10...Given an internetwork of routers using different routing protocols (such as RIP, IGRP, EIGRP and OSPF), implement an solution that will allow routes from one routing protocol to be redistributed into another routing protocol so that connectivity throughout the internetwork is assured.

11...Given a T1 connection between two distant LANs, implement Dial-on-Demand Routing (DDR) solution that will utilize an ISDN BRI connection on both routers as a backup connection in the event of a failure of the primary T1 connection. Consider the switch types of the ISDN providers and the end-point ISDN phone numbers. Ensure that the ISDN line will only be activated in the event of T1 failure and will only be used for high priority traffic.

12...Given a Protocol Analysis tool such as Sniffer or Agilent Advisor, determine the traffic patterns of a network. Specify the most-used protocol as a percentage of traffic and determine the host machines by MAC address and IP Address that are causing the most traffic. Analyze the network for percentage of utilization and detail methods of reducing the utilization percent. View a captured TCP packet; determine the source and destination MAC addresses, source and destination IP addresses, Sliding Windows size, and TCP port numbers.

13...Given a Cisco 1600/1700/2600 series router rack configured as a Frame Relay network, execute the commands that will verify PVC's, LMI statistics and mapping of IP addresses to DLCI's.

14...Given a Cisco 1600/1700/2600 series router rack, configure the routers with EIGRP, OSPF or RIP version 2 so that a multiple subnet VLSM design can be implemented. Serial links will use a 255.255.255.252 subnet while LANs will use a subnet chosen based on the number of users.

15...Given two Cisco 1600/1700/2600 series routers with ISDN BRI U interfaces and an Adtran 550 WAN Emulator (or a router simulator that's supports ISDN), implement a point-to-point ISDN connection between two LANs. Specify interesting traffic in terms of protocol or type of traffic. Create a dialer map or dialer string to call the remote network when interesting traffic occurs. Analyze layer 2 and layer 3 messages during the connection sequence.

16...Given two Cisco 1600/1700/2600 series routers with Serial and ISDN BRI U interfaces and an Adtran 550 WAN Emulator (or a router simulator that's supports ISDN), configure a T1 connection between routers (using the serial interfaces). Configure the ISDN connection to be activated only if the primary T1 connection is down. Verify the DDR configuration by shutting down the serial interface and ping the other LAN using the ISDN connection.

17...Given a three layer Enterprise network implemented with Cisco routers, create an IP addresses scheme that allows the distribution layer router to summarize all access layer routes as a single router to the core layer router. Apply the addressing scheme to the routers and use EIGRP or OSPF to effect the route summarization to the core router. Verify the summarization by displaying the routing table of the core router.

18...Given a Cisco 1600/1700/2600 series router rack, configure Network Address Translation (NAT) so that all private IP addresses on the Ethernet LAN are translated to a public IP address when Ethernet packets are out of the Serial 0 interface. Define the NAT pool as a single public IP address that all Ethernet users can utilize simultaneously. Verify that translations are occurring after a ping with the appropriate show commands.

19...Given a Cisco 1600/1700/2600 series router rack, configure FIFO, Priority Queuing, Custom Queuing and Weighted Fair Queuing one at a time and test the transfer rate for the download of a large FTP data stream in the presence of other traffic (e.g. continuous pinging).

20...Given a Cisco 1600/1700/2600 series router rack, configure the router for no compression, Stacker compression and Predictor compression one at a time. Under each setup criteria, download a large file via FTP and record the download time. Evaluate which compression method provided the highest throughput.

21...Given a Cisco 1600/1700/2600 series router rack, send a small packet from a host in one LAN to a host in another LAN. Capture the packet on the destination LAN and determine the source address and data being sent. Set up a VPN between the two hosts and send another small packet with known data between the hosts and verify that data in the captured packet cannot be read except by the authorized recipient.

How this Course helps in Achieving Your Program's Objectives:

The following matrix illustrates how this course supports achievement of your Program Objectives.

CET442	Assessment Outcomes																							
Lecture	*Testing* & Instrumentation					*Create/Implement Programming*				*Hardware/Software Design, Implem, & Eval*						*Writing Speaking*		*Team*		*Research Prob. Solv*		*Tech./Society Linkages*		
TCOs	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	3.6	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	7.3
1																								

EET/CET Program Objectives and Outcomes:

(Student competencies achieved at the time of graduation)

1. Conduct experiments involving electronic systems using modern test equipment, interpret test results and use them to improve products or methodologies.
   - 1.1. Performs Needs Analysis – define the problem
   - 1.2. States goals and objectives of the experiment
   - 1.3. Identifies resources to conduct experiment (parts, equipment, data sheets, etc.)
   - 1.4. Develops a procedure and collect data using modern test equipment
   - 1.5. Analyzes test results and draw conclusions.

2. Create, implement high-level and Assembly language programs in support of technical activities.
   - 2.1. Analyzes the problem logically
   - 2.2. Designs the solution
   - 2.3. Implements the solution
   - 2.4. Tests and debugs the software

3. For EET: Use the principles of science, mathematics, and engineering technology to design, implement, and evaluate hardware and software solutions to complex technical problems,
   - 3.1. Selects and defines a meaningful problem taking safety, ethical, social, economic, and technical constraints into consideration.
   - 3.2. Devises process to solve problem
   - 3.3. Applies appropriate knowledge of scientific, mathematical, and engineering design tools toward the design and analysis of problem solutions.
   - 3.4. Identifies key issues in designing and building a prototype
   - 3.5. Builds, tests and troubleshoots prototype
   - 3.6. Optimizes prototype with a commitment to quality, timeliness, and continuous improvement.

For CET: Use the principles of science, mathematics, software engineering, and engineering technology to design, implement, and evaluate software solutions to complex technical problems.
   - 3.1 Identifies a meaningful problem and defines preliminary solution specifications taking safety, ethical, social, economic, technical constraints, and user requirement into consideration
   - 3.2 Designs and implements appropriate data structures and algorithms
   - 3.3 Prepares a plan of action to implement the system
   - 3.4 Applies scientific, mathematical, software, and engineering design tools toward the design and analysis of problem solution
   - 3.5 Writes and tests readable and maintainable code
   - 3.6 Optimizes code with a commitment to quality, timeliness, and continuous improvement

4. Communicate effectively both orally and in writing.
   - 4.1 Communicates effectively in wiring
   - 4.2 Communicates effectively orally

5. Work effectively in a team environment.
   - 5.1 Exhibits good dialoguing skills
   - 5.2 As part of a small group project, when assigned roles, performs roles effectively

6. Apply applied research and problem-solving skills to support learning at DeVry as well as life-long personal and professional development.
   - 6.1 Recognizes the need to know information beyond one's own expertise and has the ability to gather and synthesize the necessary information into the solution of a problem
   - 6.2 Uses engineering problem-solving methodology in solving problems

7. Evaluate the broader effects of technology and to identify connections between technology and economics, politics, culture, ethical responsibility, social structure, the environment and other areas.
   - 7.1 Identifies linkages and causal relationships between technology and social, political, economic, cultural, and environmental conditions.
   - 7.2 Works effectively in diverse environments and adapts technical solution to solution a diverse audience
   - 7.3 Pursues technical work within guidelines for professional, ethical, and social responsibility

Class Policies and Procedures:

Attendance

Each student is required to attend every lecture and laboratory session in which he or she is enrolled. A swipe-card terminal (ATS) in each classroom is used to record attendance electronically. Students are responsible for arriving before class begins, sliding their identification card through the wall-mounted reader, and remaining for the duration of the course meeting. Students who are absent for two or more days should notify their Professor or assigned Academic Advisor in advance. Students who miss more than five (5) consecutive days of school are in violation of the DeVry attendance policy and will be dismissed. ***Unexcused absence in excess of 5 hours will result in a reduction of the final course grade by one letter***.

Homework

Homework is due at the beginning of class (xx00 UTC). ***Late homework is not accepted***. Homework carries the weight of one major exam (100 points) in the course. Failure to do homework will do severe damage to your grade. (UTC=Universal Coordinated Time, or Standard World Time.)

Homework will be kept in a 3-tab folder, with the latest assignment in front. Your name, the course number, and the instructor's name must appear in clearly-readable form on the front of the folder.

Laboratory Reports

Laboratory reports in this course are formal. See the Laboratory Schedule for details of laboratory due dates and report contents. In order to receive credit for a completed laboratory experiment, you must have a sign off on the cover page of your laboratory report. Laboratory reports are expected to be of your own original composition; see the Academic Integrity Policy of this syllabus. ***Laboratory reports are accepted up to one week late, with a 5 point deduction in score for each day late. Reports more than one week late are assigned a grade of zero***.

Make-Up Exams

No make up exams are given in CET442 for any reason.

Course Grading Standards

There are 3 major exams, an unspecified number of quizzes given at random intervals, various homework assignments, and a final examination given in the 15th week of the course. Your grade will be determined as follows:

2 Highest Major Exams .....… 200 points (18% each, 36% total)

Quizzes/Homework.....…….. 100 points (18%)

Final Exam..... 150 points (28%)

Laboratory Portion……. 100 points (18%; See the Laboratory Schedule for details on lab report grading)

550 points total for course; 100% as accounted for by eCollege gradebook.

Note: The lowest of the three major exams is "dropped" and does not count in the final grade calculation. No makeup exams are given. All examinations will be announced at least 1 week prior to administration. All students must take the final exam. A passing grade in lecture and laboratory is necessary in order to pass the course.

A final letter grade is to be awarded to each enrolled student in accordance with the 4.00 grading system shown below:

Letter Grade	*Percent of Total Points*	*Grade Points*
A	90 – 100%	4.00
B	80 – 89%	3.00
C	70 – 79%	2.00
D	60 – 69%	1.00
F	Below 60%	0.00

Academic Integrity Policy

Ideas and learning form the core of the academic community. In all centers of education, learning is valued and honored. No learning community can thrive if its members counterfeit their achievement and seek to establish an unfair advantage over their fellow students. The academic standards at DeVry are based on a pursuit of knowledge and assume a high level of integrity in every one of its members. When this trust is violated, the academic community suffers injury and must act to ensure that its standards remain meaningful. The vehicle for this action is the Academic Integrity Policy outlined in the *Student Handbook*.

The Academic Integrity Policy is designed to foster a fair and impartial set of standards upon which academic dishonesty will be judged. All students are required to read, understand, and adhere to these standards, which define and specify the following mandatory sanctions for such dishonest acts as copying, plagiarism, lying, unauthorized collaboration, alteration of records, bribery, and misrepresentation for the purpose of enhancing one's academic standing:

- The ***first recorded offense*** will result in the student receiving zero credit for the entire paper, exam, quiz, lab, homework assignment, or other graded activity in which the incident of academic dishonesty occurred. No partial credit may be given. Where the incident involved a graded assignment normally subject to a "drop" option, the student may not exercise that option.

- The ***second recorded offense*** will result in the student receiving a failing grade for the course in which the second offense occurs. The second offense need not be in the same course, program, or term as the first offense to invoke this sanction.

- The ***third recorded offense*** will result in the student being permanently expelled from the DeVry system. Again, the third offense need not be in the same course, program, or term as either the first or second offense to invoke the sanction.

All assignments you turn in for this course (coding, homework, laboratory, or other assignments) are expected to be your own original efforts. Do not share your work with other students. If you quote from an outside source, you must properly acknowledge the source of the information using MLA or APA style. The following sites have examples of proper usage for these styles:

`http://owl.english.purdue.edu/owl/resource/557/01/`
`http://owl.english.purdue.edu/owl/resource/560/01/`
`http://www.apastyle.org`

Changes to Syllabus:

The contents of this syllabus are subject to change with appropriate notice to the students.

Weekly Course Schedule:

Week	Topics	Textbook Chapter Reading
1	OSI model, protocol suites; address types; key ideas & definitions; LAN, MAN, and WAN systems	Ch1
2	Troubleshooting using the OSI model; network topologies; network planning and security introduction; networking hardware	Ch1, Ch2
3	Networking protocols; classful IP addressing; NAT; IP header structures and IP routed protocol operation	Ch5 Section 6
4	EXAM #1; Data link layer protocols (HDLC) introduction	Ch3
5	Routing metrics and algorithms: distance-vector routing, link-state routing, hybrid algorithms	Ch5 Section 1
6	IP routing algorithms: RIP, OSPF, E/IGRP, BGP; RIP.	Ch5 Section 2
7	IP classless addressing, subnets and subnetting techniques	Handout
8	VLSM, CIDR; autonomous systems; interior and exterior routing protocols (RIP, OSPF, EIGRP, BGP, IS-IS); route aggregation issues.	Ch5 Section 2
9	EXAM #2; DHCP, ICMP, Sockets model: UDP, TCP protocol implementations, analysis, and security implications	Ch6
10	TCP analysis and packet tracing methods; network traffic analysis techniques; SSL.	Ch6
11	DNS operation and administration; DNS protocol suite	Ch7
12	HTTP, FTP, IIS design and administration	Ch7, Handout
13	VPNs, WAP security, Encryption Protocols	Handout
14	EXAM #3 & Wrap-Up	