

CSET 4750 Computer Networks and Data Communications (4 semester credit hours)

CSET Required  
IT Required

**Current Catalog Description:**

Computer network architectures and their application to industry needs. Major topics include vocabulary, hardware, design concepts, current issues, trends, hardware, multi-user operating systems, network protocols, local and wide area networks, intranet and internet communications, analog and digital data transmissions. Prerequisite: CSET 2200

**Textbooks:**

*Internetworking with TCP/IP Volume 1: Principles, Protocols, and Architecture*, Fifth Edition, Douglas Comer, 2006, Pearson Prentice Hall.

**References:**

Course web pages: <http://cset.sp.utoledo.edu/cset4750/>

**Related Program Outcomes:**

CSET Program Outcomes are (a, b, c, e, and i)

IT Program Outcomes are (a, b, c, e, and i)

**Course Objectives:**

After successful completion of this course, students will be able to:

- Use advanced networking to plan and deploy internetworks.
- Provide an understanding of sub-networks
- Work with the Internetworking concepts:
  - Implement and manage the functions of the Internet protocol suite: TCP/IP
  - Develop IP address based sub-networking
  - Implement IP Routing and Routing Protocols
  - Debug transport level services
  - Manipulate and troubleshoot application services: E-mail, FTP, Rlogin etc.
- Gain hands-on experience with network hardware
  - Routers (emphasis)
  - Switches
- Gain an understanding of the widely used Unix servers across the Internet
  - Troubleshoot end to end connectivity problems
  - Diagnose packets, frames and segments traversing a network.
- Gain hands-on experience with real-world Cisco routers and switches
  - Describe the various Cisco IOS software features
  - Implement Basic IOS Configuration
  - Describe Remote Management
  - Develop and implement network designs

## Major Topics Covered in the Course

Topic	Lecture Hours	Lab Hours
Networks and Inter-networks	3	
The OSI Model	3	
Physical Layer	3	2
Data Link Layer	3	2
Transport Layer and Session Layer	3	2
Presentation and Application Layer	3	2
Network Layer	3	4
IP Addressing and Sub-netting: IPv4, DHCP, IPv6	6	4
Wide Area Network Design	3	
Data Path Determination	3	2
Basic Router Operations and Configuration	3	4
IP Routing: RIP, OSPF, BGP	6	6
Network Security: NAT, Proxy Servers, Firewalls	3	2
Totals	45	30

### Laboratory Projects:

Students create a small local area network and perform packet analysis on data packets at the data-link, network, and transport layers. A second project requires capture and analysis of data packets in the application layer and social implications “sniffing” are examined.

Students also create a three node wide-area network and implement data routing using interior routing protocols (static, distance-vector, shortest path first) and exterior routing protocols (BGP). A second aspect of this project is the implementation of NAT and Access-Control Lists (including extended and “secure”). The three node network is expanded to encompass 12 nodes and issues of remote management and cooperation among “foreign” domains is examined.

### Oral and Written Communications

Midterm and Final examinations are written using essay format.

### Social and Ethical Issues

The topics discussed in the Application Layer in the OSI model include data (packet) capture and analysis. The ethical implications of capturing data packets in the application layer are discussed and examined. The social and ethical implications of Denial of Service (DOS) attacks and defenses and intrusion detection are discussed in the Network Security topics. Students are given an essay question on the midterm and responses are graded. Three hours of class time is spent on this topic.

## **Theoretical Content**

Theoretical content includes:

- Introduction to computer networks, their hardware and software. [1 week]
- Connection oriented and connectionless services. [0.5 week]
- Circuit switching and packet switching. [0.5 week]
- OSI and TCP/IP reference models. [3.5 weeks]
  - Discussion of physical, data-link layers of the OSI Model
  - Discussion of network layer of the OSI Model
  - Discussion of the transport, and session layers of the OSI Model
  - Discussion of the presentation and application layer of the OSI Model.
- Transmission media and multiplexing. [1 week]
- Data link layer protocols: multiple access protocols and LANs using CSMA/CD [1 week]
- IEEE standards 802.2, 802.3, 802.4, 802.5, 802.6. [0.5 week]
- Network layer [4 weeks]
  - LAN and WAN design issues.
  - IP Address allocation and subnetting/supernetting issues
  - Routing Algorithms: Distance Vector, Shortest Path First, link state, hierarchical, broadcast, and multicast routing.

## **Problem Analysis**

In assignments and exams, students are presented with network data problems requiring them to analyze the success or failure of arp cache generation, ip address subnetting, tcpdump analysis, name service resolution problems, classful routing problems (RIPv1), spf algorithm implementation issues, access control via NAT and access-lists, and network design problems.

## **Solution Design**

This course requires students to implement a three node wide-area network using (a) static routing, (b) dynamic routing with distance-vector algorithms, (c) dynamic routing using shortest path first algorithms (Dijkstra), and (c) access to networks using Network Address Translation access-lists.

## **Course Coordinator:**

Allen Rioux (allen.rioux@utoledo.edu)  
2-28-2011

## Syllabus: CSET 4750

	Student Outcomes: CSET Program	Course Outcomes	Assessment Methods
a	an ability to select and apply knowledge of computing and mathematics appropriate to the discipline. Specifically, an ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices. [CAC-j]	Students will be able to use the current standard routing equipment to solve networking problems.	Midterm Examination problem – requires understanding of networks, network gateways, and application level services to solve a communication problem.  Final Examination question – discuss limitations and propose an alternative to IPv4, and/or TCP (and UDP)
b	an ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.	Students will be able to solve a variety of LAN based data transmission problems.	Midterm Examination problem – understand ARP communication failure, MAC to IP address issues, and IP network communication limits  Midterm Examination question – interpret and determine whether the transactions identified in a Unix tcpdump trace completed.
c	an ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs. Specifically, an ability to apply design and development principles in the construction of software systems of varying complexity. [CAC-k]	Students will be able to design an effective and efficient wide-area network routing solution.	Final Examination problem – design and implement a 3 node network with requirements for routing, NAT, and access control. Produce router configurations.
d	an ability to function effectively as a member or leader on technical teams to accomplish a common goal.		
e	an understanding of professional, ethical, legal, security and social issues and responsibilities including a respect for diversity.	Students will understand some of the professional and ethical issues surrounding computer networking	Midterm Examination question – discuss the practical and ethical issues of using tcpdump vs. wireshark for network monitoring/troubleshooting
f	an ability to communicate effectively with a range of audiences using a range of modalities including written, oral and graphical.		
g	an ability to analyze the local and global impact of computing on individuals, organizations, and society.		
h	recognition and understanding of the need for and an ability to engage in self-directed continuing professional development.		
i	an ability to select and apply current techniques, skills, and tools necessary for computing practice.	Students will be able to troubleshoot LAN and WAN problems.	Midterm Examination problem – propose a network design to efficiently utilize IP space; select proper IP addresses from unallocated pools.  Final Examination question – select and identify proper routing components to solve a wide-area network problem
j	an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.		
k	a commitment to quality, timeliness, and continuous improvement.		

## Syllabus: CSET 4750

	ABET Course Outcomes: IT Program	Course Outcomes	Assessment Methods
a	an ability to select and apply knowledge of computing and mathematics appropriate to the discipline. Specifically, an ability to use and apply current technical concepts and practices in the core information technologies. [IT-j]	Students will be able to use the current standard routing equipment to solve networking problems.	Midterm Examination problem – requires understanding of networks, network gateways, and application level services to solve a communication problem.  Final Examination question – discuss limitations and propose an alternative to IPv4, and/or TCP (and UDP)
b	an ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.	Students will be able to solve a variety of LAN based data transmission problems.	Midterm Examination problem – understand ARP communication failure, MAC to IP address issues, and IP network communication limits  Midterm Examination question – interpret and determine whether the transactions identified in a Unix tcpdump trace completed.
c	an ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs. And, an ability to identify and analyze user needs and take them into account in the selection, creation, evaluation and administration of computer-based systems. [IT-k]	Students will be able to design an effective and efficient wide-area network routing solution.	Final Examination problem – design and implement a 3 node network with requirements for routing, NAT, and access control. Produce router configurations.
d	an ability to function effectively as a member or leader on technical teams to accomplish a common goal.		
e	an understanding of professional, ethical, legal, security and social issues and responsibilities including a respect for diversity.	Students will understand some of the professional and ethical issues surrounding computer networking	Midterm Examination question – discuss the practical and ethical issues of using tcpdump vs. wireshark for network monitoring/troubleshooting
f	an ability to communicate effectively with a range of audiences using a range of modalities including written, oral and graphical.		
g	an ability to analyze the local and global impact of computing on individuals, organizations, and society.		
h	recognition and understanding of the need for and an ability to engage in self-directed continuing professional development.		
i	an ability to select and apply current techniques, skills, and tools necessary for computing practice. And an ability to effectively integrate IT-based solutions into the user environment. [IT-l]	Students will be able to troubleshoot LAN and WAN problems.	Midterm Examination problem – propose a network design to efficiently utilize IP space; select proper IP addresses from unallocated pools.  Final Examination question – select and identify proper routing components to solve a wide-area network problem
j	an understanding of best practices and their application. [IT-m]		
k	an ability to assist in the creation of an effective project plan. [IT-n]		