Computer Science Department
cs.salemstate.edu

ITE310 Computer Networks **4 cr.**

Catalog description:

This course begins with an introduction to computer networks, including hardware, software, troubleshooting, and maintenance. IT professionals need to understand various components of the networking infrastructure of an organization as well as the various protocols and standards used to implement these infrastructures. TCP/IP stack will be presented with the discussion of OSI layered model and data/control flow through each layer using top-down or bottom-up approaches. Understanding of networking protocols, TCP/IP stack, and troubleshooting, and maintenance of networks will be given through class lectures as well as labs. Three lecture hours and three hours of scheduled laboratory per week.

Prerequisites: ITE100, ITE105

Course Narrative

The emphasis of this course is on the thorough understanding of how to network computers using software and hardware tools. A computer network is implemented as a multilayered structure (standard ISO OSI model and TCP/IP model), which extends from a standalone computer to the Internet that covers the whole globe. Each layer is comprised of hardware and software, each layer implements a set of communication protocols, and each layer presents a number of design and implementation challenges that are taken care of by a set of mechanisms, tools, and organizational methods. The course uses a top-down or bottom-up approach, going from a standalone system to the World Wide Web or from the World Wide Web down to physical layer, networking protocols, and mechanisms for each layer are described.

Through lecture and labs, students will be given a thorough understanding of Local Area Networks and Wide Area Networks. Through step-by-step understanding of each layer, they get to understand how various layers of the TCP/IP suite come together in the form of LANs, WANs, and the Internet.

Goals:

Upon successful completion of the course, a student should be able to do the following:

- G1: identify basic issues, problems, and solutions in designing and building computer networks taking into consideration the computing environment as a whole;
- G2: describe all elements (software, hardware, organizational structures) used in building computer networks;
- G3: use standards and protocols required to analyze and design computer networks;
- G4: analyze components and organizational methods used by network administrators to ensure functionality of a distributed environment (robustness, throughput, availability, reliability, etc.);
- G5: describe rules, regulations, legal issues, and necessary administrative measures required to build a networked computing environment;

Course Objectives:

Upon successful completion of the course, a student will have demonstrated the ability to:

- O1: apply correct technical terminology when analyzing requirements, describing the main issues, and designing solutions for computer networks;
- O2: identify all necessary components of computer networks and distributed environments, explain methods and technologies that are used in network design and creation, and demonstrate application of these techniques in practical exercises;
- O3: analyze and apply assessment techniques that allow objective evaluation of the characteristics and vulnerabilities of a distributed computing environment, and to develop skills in using these techniques to design a practical solution based on a customer's requirements;
- O4: utilize knowledge and understanding of standards (systems and protocols) used in creation of networks when designing a network;
- O5: analyze customer's requirements and specifications, formulate specifications for a distributed environment (design blueprints, component specification, policies and procedures, etc.) and communicate (verbally and in writing) clearly and concisely these requirements to system managers, administrators, business users, etc.;
- O6: work collectively with stakeholders and other members of the design team in analyzing requirements, discussing characteristics of a networked environment, analyzing issues, and designing and implementing solutions.

Program Objective / Course Objective matrix (For ABET Accreditation Purposes)

(The following Matrix maps the Program Objectives for Information Technology Program outlined by Accreditation Board of Engineering Technology (ABET) with the Course Objectives. The check marks below the course objective represent that those course objectives accomplish specific program objectives set forth by ABET. The program objectives that have a * in front of them means that that course does not address those program objectives.)

Program Objective	O1	O2	O3	O4	O5	O6
PO-A: An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline.	✓	✓	✓	✓	✓	✓
PO-B: An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.				✓	✓	✓
PO-C: An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.		✓	✓	✓	✓	✓
PO-D: An ability to function effectively on teams to accomplish a common goal.		✓	✓			✓
PO-E: An understanding of professional, ethical, legal, security and social issues and responsibilities.	✓	✓			✓	✓
PO-F: An ability to communicate effectively with a range of audiences.	✓				✓	✓
PO-G: An ability to analyze the local and global impact of computing on individuals, organizations, and society.	✓	✓			✓	✓

Program Objective	O1	O2	O3	O4	O5	O6
***PO-H:** Recognition of the need for and an ability to engage in continuing professional development.						
PO-I: An ability to use current techniques, skills, and tools necessary for computing practice.	✓	✓	✓			
PO-J: An ability to use and apply current technical concepts and practices in the core information technologies.	✓	✓	✓	✓	✓	✓
PO-K: An ability to identify and analyze user needs and take them into account in the selection, creation, evaluation and administration of computer-based systems.	✓	✓			✓	✓
PO-L: An ability to effectively integrate IT-based solutions into the user environment.		✓	✓			✓
PO-M: An understanding of best practices and standards and their application.					✓	✓
PO-N: An ability to assist in the creation of an effective project plan.					✓	✓

Course topics:

The column on the right hand side represents the Body of Knowledge and number of hours (in parenthesis) set forth by ABET accreditation board for accomplishing minimum required hours assigned for different categories. More information on this body of knowledge can be found in Appendix A "The IT Body of Knowledge" on Page 68 of the following document.
http://www.acm.org//education/curricula/IT2008%20Curriculum.pdf

It is upon instructor's discretion and personal preference to teach the following topics in the top-down or bottom-up approach to OSI and TCP/IP Layers.

- Principles of networking NET1(1.5), ITF(1)
  - What is the Internet?
  - Circuit vs. Packet Switching
  - ISPs and Internet Backbones
  - Protocol Layers and their Service Models
  - History of Computer Networks

- Place of networking software in Operating System Environment IPT1(0.5), PT1(1), SA1(1)
  - Interprocess communication
  - Network as application software
  - Network as a part of OS
  - Network as a device driver
  - Network configuration and administration as a part of overall computing environment
  - OSI model vs. TCP/IP model

- *The Application layer (OSI layer 5-7) and the Web* NET1(0.5), PT1(1), NET6(2)
    - Client-server vs. point-to-point communication models/protocols
    - Human-usable destination identification (host naming rules and architecture of DNS)
    - TCP/IP based applications (Telnet, SMTP, SNMP, FTP, etc.)
    - World Wide Web (WWW) network architecture and protocols
    - WWW servers and clients (server-side and client-side applications, Java Machine)
    - Overview of WWW control and data flow (from HTTP to physical layer)
    - Database and File Service applications.

- *The Transport Layer (OSI layer 4)* PT1(0.5), IPT1(0.5), NET1(1.5)
    - Introduction to Transport Layer Services
    - Connectionless Transport, UDP vs. Connection Oriented Transport, TCP
    - Principles of Reliable Data Transfer/Congestion Control

- *The Network Layer (OSI layer 3)* PT1(0.5), NET1(0.5), *PT4(0.5) (not core)*
    - Introduction to Forwarding and Routing
    - Virtual Circuit and Datagram Networks
    - Router and router design NET2(1), *PT5(1)(not core), PT6(1) (not core)*
    - IPv4 vs. IPv6 NET2(1)
    - Routing Algorithms and Routing in the Internet NET2(2)
    - General issues in managing TCP/IP-based network infrastructure
        - IP address assignment issues, networks and subnets configuration
        - Address assignment and renumbering problem and solution (DHCP)
        - Local/remote management methods and tools (SNMP)
        - Network sniffers and traffic analysis tools

- Wide Area Networks PT3(1), NET2(2), SIA3(2), SIA6(1), NET5(1)
    - Interconnecting LANs (creation of the Internet)
    - Communication channel bandwidth sharing problem and solution
    - Creating an Unreliable Packet Switched Network (OSI layer 3)
    - Routers, routing protocols and administration and configuration of Layer 3 data flow
    - Making Unreliable Packet Switched Network reliable (OSI layer 4)
    - Connectionless and connection-based protocols (UDP and TCP)
    - Different communication techniques (channels and protocols) used in WAN

- *The Link Layer and Physical Layer (OSI Layers 2 and 1 respectively)*
  NET3(3), PT1(0.5), SIA7(1)
    - Framing, Checksum, Error Detection, and Correction
    - Physical Media, Shannon's Law, and Channel Capacity
    - Local Area Networks NET1(1), NET2(3),NET3(3), NET5(1)
        - Properties and characteristics of communication channels (OSI layer 1)
        - LAN topologies (connecting multiple computers)
        - Physical vs. Logical topology (control and data flow)
        - Unique LAN node identification
        - Throughput collapse and solution - switches (LAN and VLAN)
        - Ethernet Data Link Layer (OSI layer 2)

        - Wireless (OSI layer 2) and Mobile Links
        - Designing, managing, and troubleshooting LAN

- Introduction to Security NET4(2)
    - Fundamentals of Cryptography
    - Symmetric Key vs Public Key Cryptography
    - Wired vs. Wireless Security

- Use of network analysis tools, packet analyzers, etc. for lab purposes

Student Experiences:

Organization of the course

The course consists of lectures, labs, homework assignments, quizzes, and exams – a midterm and a final. Lectures include exercises that may consist of:

- Discussions of the material presented during lectures
- Analysis of presented network layers (protocols, devices, organizational/administrative methods)
- Usage of tools available to IT professionals to analyze networks

Group discussion time and group presentations that will be conducted as part of the scheduled laboratory sessions are an integral component of the course, serving to reinforce the concepts and techniques presented during lectures.

Assignments:

Homework assignments include analysis of network components and design of solutions for network and related tasks, as well as exercises in using network tools. Assignments require students to use information given during the lectures and in textbooks, and to perform Internet research for necessary materials. Regular writing assignments include but are not limited to:

- review of technical articles;
- presentation of research findings;
- analysis and evaluation of methodologies used in building networked environments;

Specific requirements for each assignment will be stated when the assignment is distributed; all written submissions will be graded against the Writing rubric. Presentations will be assessed based on the Presentation rubric.

Labs:

Weekly labs consist of hands-on exercises that include:

- Analyzing different network designs and writing reports
- Running traffic analysis tools and protocol analyzers

All lab reports must conform to guidelines announced in class. Projects will be assessed and graded against the Project Implementation rubric.

Quizzes, Tests and Examinations: There will be four quizzes (each covering a major topic), a midterm, and a cumulative final. Quizzes and exams will include multiple choice and problem solving tasks.

Grading: Final grades will be determined on the basis of the following approximate weights:

- Laboratory exercises 25%
- Homework assignments 25%
- Quizzes 20%
- Midterm exam 15%
- Final exam 15%

Course Objective / Assessment Mechanism matrix

	Lab assignments	Homework assignment	Quizzes	Midterm exam	Final Exam
CO1	✓	✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3	✓	✓		✓	✓
CO4	✓	✓	✓		
CO5	✓	✓			
CO6	✓	✓			

Bibliography:

- James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6th Edition, ISBN-13: 978-0132856201, 2015.
- Mike Meyers, CompTIA Network+ Certification All-in-One Exam Guide, 5th Edition, ISBN-13: 978-0071789226, 2012.
- Behrouz A. Forouzan, Firouz Mosharraf, Computer Networks: A Top Down Approach, 1st Edition, ISBN-13: 978-0073523262, 2011.
- Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, 5th Edition, ISBN-13: 978-0132126953, 2010.