

**University of Hawaii Maui College**  
**ETRO 140 - Fundamentals of Computer Networking**

**1. Course Alpha.**

ETRO

**2. Course Number.**

140

**3. Course Title/Catalog Title.**

Fundamentals of Computer Networking

**4. Number of Credits.**

4

**5. Contact Hours/Type.**

- Hour lecture/lab (6)

**6. Course Description.**

Introduces the OSI and TCP/IP models for network communication, discusses industry standards, commonly used network topologies, IPv4 and IPv6 addressing, routing and switching concepts, ACLs, DHCP, NAT; queuing models, network architecture design and troubleshooting; introduces wireless networking and Virtual-LANs, prepares students for the Cisco Certified Entry Networking Technician (CCENT) exam.

**7. Pre-Requisites.**

ETRO 105      Circuit Analysis I

MATH 119      ENGINEERING PRECALCULUS (New course for ECET majors which is more relevant to the fundamental engineering concepts discussed in this course ); OR consent

ETRO 105 and MATH 119, both with grade C or better. or consent.

**8. Co-requisites.**

None

**9. Recommended Preparation.**

ICS 111, MATH 115.

**10. Is this a cross-listed course?**

NO

**11. Reason for Proposal. Why is this course being proposed or modified? This question requires specific information as part of the explanation.**

The course pre-requisite for ETRO 140 has changed from ETRO 101 to ETRO 105 in order to ensure students are prepared to succeed in the program. ETRO 101 is no longer in the program map as a result of the changes made to the ECET AS degree program map: the credits are reduced from 74 to 61 in part as a response to the system office

initiative "15 to finish." Students can graduate in 4 semesters instead of 6 semesters.

The changes done are also to include newer technology that is relevant to the workforce and articulates with other CCs in the UH system.

**12. Effective Semester and Year.**

Fall 2015

**13. Grading Method. What grading methods may be used for this course?**

- Standard (Letter,Cr/NCr,Audit) (0)

**14. Is this course repeatable for credit? How often can this course be counted toward a degree or certificate?**

NO

**15. Course Student Learning Outcomes (SLOs). DO NOT ENTER TEXT IN THE TEXT BOX BELOW. Click on the yellow button "COURSE LEARNING OUTCOMES" and enter in that screen.**

| Course SLO/Competency   | I. Design and build basic networking architectures for various applications. | II. Be able to choose and execute various router, switch, hosts and hub configuration commands in order for setting up desired system architecture. | III. Use mathematical analysis to simplify the network layout and subnetting of the address space provided. | IV. Explain various routing and switching algorithms used in the Internet as a whole. | V. Describe various computer networking technologies existing on various layers of the OSI model and their workings. |
|---|--|---|---|---|--|
| Explain and apply the principles of network communication. Compare and contrast networking technologies.  | <input checked="" type="checkbox"/>  |   |   |   | <input checked="" type="checkbox"/>  |
| Explain the various network communication models such as Open System Interface (OSI) and TCP/IP model and describe networking protocols at individual layers of these models. |  |   |   |   | <input checked="" type="checkbox"/>  |
| Identify and describe the purpose and characteristics of Ethernet framing, MAC addresses, and ARP.  | <input checked="" type="checkbox"/>  |   |   |   |  |
| Explain basic concepts of Ethernet technology including switching, addressing and multiple access schemes. Understand wired standards such as IEEE 802.3 or IETF RFCs.        | <input checked="" type="checkbox"/>  |   | <input checked="" type="checkbox"/>   |   | <input checked="" type="checkbox"/>  |
| Explain and demonstrate concepts of routing and switching in LAN and WANs.  | <input checked="" type="checkbox"/>  | <input checked="" type="checkbox"/>   |   | <input checked="" type="checkbox"/>   | <input checked="" type="checkbox"/>  |
| Explain concepts of flow-control, sequencing, congestion and queuing in the context of Computer Networking.   |  |   | <input checked="" type="checkbox"/>   | <input checked="" type="checkbox"/>   | <input checked="" type="checkbox"/>  |
| Explain and implement addressing and naming schemes at various layers of data networks in IPv4 and IPv6 environments.   | <input checked="" type="checkbox"/>  | <input checked="" type="checkbox"/>   | <input checked="" type="checkbox"/>   |   |  |

|  |                                     |                                     |                                     |  |                                     |
|--|-------------------------------------|-------------------------------------|-------------------------------------|--|-------------------------------------|
| Design and implement fixed and variable length IPv4 addressing schemes including: Determining the subnet mask to support a specified number of hosts to be assigned to each subnet and Determining the subnet addresses and range of host addresses for each subnet for the final addressing scheme. | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |  |                                     |
| Describe and demonstrate the operations and benefits of Dynamic Host Configuration Protocol (DHCP) and Network Address Translation (NAT) for IPv4 and IPv6 networks.   | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |                                     |  | <input checked="" type="checkbox"/> |
| Describe basic concepts and configurations Virtual Local Area Networks (VLAN).   |                                     | <input checked="" type="checkbox"/> |                                     |  | <input checked="" type="checkbox"/> |
| Describe the basic requirements for a reliable network.  |                                     |                                     |                                     |  | <input checked="" type="checkbox"/> |
| Use the output of ping, tracert, ipconfig, and show commands to establish network baselines and perform troubleshooting within a network.  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |                                     |  |                                     |
| Describe and identify commonly used distance vector routing protocols, such as RIP and RIPng, and link-state routing protocols, such as OSPFv2 and OSPFv3.   |                                     |                                     |                                     |  | <input checked="" type="checkbox"/> |

| Course SLO/PSLO   | Analyze, design, and implement electro-optic systems, control systems, instrumentation systems, communication systems, computer systems, or power systems. | Utilize appropriate mathematics at the level of algebra and trigonometry to solve technical problems. | Demonstrate critical engineering technology skills and experiences such as: making existing technology operate, creating/selecting new technology, troubleshooting, calibrating, characterizing, and optimizing. | Demonstrate engineer's way of thinking, analyzing technology as systems. |
|---|--|---|--|--|
| I. Design and build basic networking architectures for various applications.  | <input checked="" type="checkbox"/>  | <input checked="" type="checkbox"/>   | <input checked="" type="checkbox"/>  | <input checked="" type="checkbox"/>                                      |
| II. Be able to choose and execute various router, switch, hosts and hub configuration commands in order for setting up desired system architecture. | <input checked="" type="checkbox"/>  |   | <input checked="" type="checkbox"/>  | <input checked="" type="checkbox"/>                                      |
| III. Use mathematical analysis to simplify the network layout and subnetting of the address space provided.   | <input checked="" type="checkbox"/>  | <input checked="" type="checkbox"/>   |  | <input checked="" type="checkbox"/>                                      |
| IV. Explain various routing and switching algorithms used in the Internet as a whole.   | <input checked="" type="checkbox"/>  |   | <input checked="" type="checkbox"/>  | <input checked="" type="checkbox"/>                                      |
| V. Describe various computer networking technologies existing on various layers of the OSI model and their workings.                                | <input checked="" type="checkbox"/>  |   |  | <input checked="" type="checkbox"/>                                      |

**16. Course Competencies. DO NOT ENTER TEXT IN THE TEXT BOX BELOW. Click on the yellow button "COURSE COMPETENCIES/ISSUES/SKILLS" and enter text in that screen. Course competencies are smaller, simpler tasks that connect to and facilitate the SLOs.**

| Competency   |
|--|
| Explain and apply the principles of network communication. Compare and contrast networking technologies.   |
| Explain the various network communication models such as Open System Interface (OSI) and TCP/IP model and describe networking protocols at individual layers of these models.  |
| Identify and describe the purpose and characteristics of Ethernet framing, MAC addresses, and ARP.   |
| Explain basic concepts of Ethernet technology including switching, addressing and multiple access schemes. Understand wired standards such as IEEE 802.3 or IETF RFCs.   |
| Explain and demonstrate concepts of routing and switching in LAN and WANs.   |
| Explain concepts of flow-control, sequencing, congestion and queuing in the context of Computer Networking.  |
| Explain and implement addressing and naming schemes at various layers of data networks in IPv4 and IPv6 environments.  |
| Design and implement fixed and variable length IPv4 addressing schemes including: Determining the subnet mask to support a specified number of hosts to be assigned to each subnet and Determining the subnet addresses and range of host addresses for each subnet for the final addressing scheme. |
| Describe and demonstrate the operations and benefits of Dynamic Host Configuration Protocol (DHCP) and Network Address Translation (NAT) for IPv4 and IPv6 networks.   |
| Describe basic concepts and configurations Virtual Local Area Networks (VLAN).   |
| Describe the basic requirements for a reliable network.  |
| Use the output of ping, tracert, ipconfig, and show commands to establish network baselines and perform troubleshooting within a network.  |
| Describe and identify commonly used distance vector routing protocols, such as RIP and RIPng, and link-state routing protocols, such as OSPFv2 and OSPFv3.   |

**17. Recommended Course Content and Timeline. The course content facilitates the course competencies. Course content may be organized by weeks, units, topics or the like.**

| Content   |
|---|
| 1 week: Explain and apply the principles of network communication. Compare and contrast networking technologies. Understand the various network communication models such as Open System Interface (OSI) and TCP/IP model.  |
| 1 week: Describe networking protocols at various layers such of OSI model such as physical layer, Medium Access Control, IP and Transport protocols. Explain significance of each layer such as MAC for channel access, IP for routing and TCP for end-to-end connectivity.   |
| 1 week: Explain basic concepts of Medium Access control such as Aloha, Slotted Aloha, CSMA/CD and CSMA/CA. Introduce switching and protocols such as Ethernet, IEEE 802.3 standard.   |
| 2 weeks: Understand concepts of routing and how it ties into switching of PDUs. Introduce static and dynamic routing; distance vector routing and link-state routing; RIP and OSPF and other contemporary protocols. Understand the difference between switching and routing and specifically discuss sub-netting in IPv4 environment.  |
| 2 weeks: Discuss the concept of TCP segmentation and re-assembly in more detail. Explain flow-control on a end-to-end basis and introduce the "slow-start" mechanism of TCP. Discuss sequencing of TCP fragments for re-assembly. Discuss congestion control and queuing using Little's Theorem and algorithms such as Weighted Fair Queuing and Random early detection. Describe various Transport layer protocols such as TCP, RTP and UDP. |
| 2 weeks: Build and test network architecture. Analyze network performance by measuring aspects such as bandwidth utilization, channel goodput, access control and so on. Introduce IPv6 networking. Start semester project on Computer Networking.  |
| 1-2 weeks: Discuss the concepts of DHCP and NAT.  |
| 1 week: Discuss dynamic networks and wireless networking concepts and wireless standards such as IEEE 802.11.   |
| 1 week: Introduce concept of Virtual-LANs in wired and wireless networking.   |
| 1-2 weeks: Final presentation and discussion on applications of computer communication protocols such as web-surfing, remote file transfers, streaming media, collaborative workspaces and so on.   |

18. Program Learning Outcomes. DO NOT ENTER TEXT IN THE TEXT BOX BELOW. Click on the yellow button "PLOs" and enter text in that screen. Program Student Learning Outcomes (PLOs) supported by this course. If you are not a "program" use the Liberal Arts PLOs, view them by clicking on ? icon to the right.

**Program SLO**

Analyze, design, and implement electro-optic systems, control systems, instrumentation systems, communication systems, computer systems, or power systems.

Utilize appropriate mathematics at the level of algebra and trigonometry to solve technical problems.

Demonstrate critical engineering technology skills and experiences such as: making existing technology operate, creating/selecting new technology, troubleshooting, calibrating, characterizing, and optimizing.

Demonstrate engineer's way of thinking, analyzing technology as systems.

19. College-wide Academic Student Learning Outcomes (CASLOs). FIRST, fill out the CASLO grid located in the UHMC tab above. Click on the HELP icon for tips on determining support for the CASLOs and indicate your choices below by clicking on the box in front of each supported CASLO. NOTE: Our campus does not use the Preparatory Level, Level 1 and Level 2 designations in the chart below.

|                                     |   |
|-------------------------------------|---|
| <input checked="" type="checkbox"/> | <b>Creativity</b> - Able to express originality through a variety of forms.<br><input checked="" type="checkbox"/> Preparatory Level  |
| <input checked="" type="checkbox"/> | <b>Critical Thinking</b> - Apply critical thinking skills to effectively address the challenges and solve problems.<br><input checked="" type="checkbox"/> Level 1  |
| <input checked="" type="checkbox"/> | <b>Information Retrieval and Technology</b> - Access, evaluate, and utilize information effectively, ethically, and responsibly.<br><input checked="" type="checkbox"/> Level 1   |
|                                     | <b>Oral Communication</b> - Practice ethical and responsible oral communications appropriately to a variety of audiences and purposes.  |
| <input checked="" type="checkbox"/> | <b>Quantitative Reasoning</b> - Synthesize and articulate information using appropriate mathematical methods to solve problems of quantitative reasoning accurately and appropriately.<br><input checked="" type="checkbox"/> Preparatory Level |
| <input checked="" type="checkbox"/> | <b>Written Communication</b> - Write effectively to convey ideas that meet the needs of specific audiences and purposes.<br><input checked="" type="checkbox"/> Preparatory Level   |

20. Linking. CLICK ON CHAIN LINK ICON IN UPPER RIGHT HAND CORNER TO BEGIN LINKING.

21. Method(s) of delivery appropriate for this course.

- Classroom/Lab (0)

22. Text and Materials, Reference Materials, and Auxiliary Materials.

This class will follow the Cisco Networking Academy Program CCNA 1 and 2 course materials through Cisco Networking Academy Program on-line coursework and published companion guide.

Reference material: Computer Networks (5th edition), Andrew S. Tanenbaum, Prentice Hall

23. Maximum enrollment.

**24. Particular room type requirement. Is this course restricted to particular room type?**

YES

Lab with all the equipment needed for the course (computers and networking materials). Routers and switches as internetworking devices will be needed and a experimental setup is required with ability to test various web-based services for various router and switch configurations.

**25. Special scheduling considerations. Are there special scheduling considerations for this course?**

YES

Must fit the ECET AS degree course scheduling.

**26. Are special or additional resources needed for this course?**

Electronics equipment: Cisco network hardware such as routers and switches. Network measurement and analyzing tools and meters. Simulation software such as Packet Tracer and software environment of Java Runtime will be needed.

**27. Does this course require special fees to be paid for by students?**

NO

**28. Does this course change the number of required credit hours in a degree or certificate?**

No.

**29. Course designation(s) for the Liberal Arts A.A. degree and/or for the college's other associate degrees.**

| Degree                   | Program      | Category                 |
|--------------------------|--------------|--------------------------|
| Associate in Arts:       | Liberal Arts | LE - Elective            |
|                          |              | LE - Elective            |
| AS:                      | ECET - All   | PR - Program Requirement |
| AAS:                     |              |                          |
| BAS:                     |              |                          |
| Developmental/ Remedial: |              |                          |

**30. Course designation(s) for other colleges in the UH system.**

This course transfers as an elective. This course transfers to Kaua'i CC, Hawai'i CC and Honolulu CC as well as to Manoa.

**31. Indicate the year and page # of UHMC catalog referred to. For new or modified courses, please indicate the catalog pages that need to be modified and provide a sheet outlining those changes.**

Referred catalog and modifications: pages 112 in UHMC's 2014 general catalog.

### 32. College-wide Academic Student Learner Outcomes (CASLOs).

|  |   |
|--|---|
| <b>Standard 1 - Written Communication</b>  |   |
| Write effectively to convey ideas that meet the needs of specific audiences and purposes.  |   |
| Outcome 1.1 - Use writing to discover and articulate ideas.  | 2 |
| Outcome 1.2 - Identify and analyze the audience and purpose for any intended communication.  | 1 |
| Outcome 1.3 - Choose language, style, and organization appropriate to particular purposes and audiences.   | 1 |
| Outcome 1.4 - Gather information and document sources appropriately.   | 2 |
| Outcome 1.5 - Express a main idea as a thesis, hypothesis, or other appropriate statement.   | 2 |
| Outcome 1.6 - Develop a main idea clearly and concisely with appropriate content.  | 2 |
| Outcome 1.7 - Demonstrate a mastery of the conventions of writing, including grammar, spelling, and mechanics.   | 1 |
| Outcome 1.8 - Demonstrate proficiency in revision and editing.   | 1 |
| Outcome 1.9 - Develop a personal voice in written communication.   | 0 |
| <b>Standard 2 - Quantitative Reasoning</b>   |   |
| Synthesize and articulate information using appropriate mathematical methods to solve problems of quantitative reasoning accurately and appropriately. |   |
| Outcome 2.1 - Apply numeric, graphic, and symbolic skills and other forms of quantitative reasoning accurately and appropriately.                      | 2 |
| Outcome 2.2 - Demonstrate mastery of mathematical concepts, skills, and applications, using technology when appropriate.                               | 3 |
| Outcome 2.3 - Communicate clearly and concisely the methods and results of quantitative problem solving.   | 2 |
| Outcome 2.4 - Formulate and test hypotheses using numerical experimentation.   | 0 |
| Outcome 2.5 - Define quantitative issues and problems, gather relevant information, analyze that information, and present results.                     | 1 |
| Outcome 2.6 - Assess the validity of statistical conclusions.  | 2 |
| <b>Standard 3 - Information Retrieval and Technology.</b>  |   |
| Access, evaluate, and utilize information effectively, ethically, and responsibly.   |   |
| Outcome 3.1 - Use print and electronic information technology ethically and responsibly.   | 1 |
| Outcome 3.2 - Demonstrate knowledge of basic vocabulary, concepts, and operations of information retrieval and technology.                             | 1 |
| Outcome 3.3 - Recognize, identify, and define an information need.   | 1 |
| Outcome 3.4 - Access and retrieve information through print and electronic media, evaluating the accuracy and authenticity of that information.        | 1 |
| Outcome 3.5 - Create, manage, organize, and communicate information through electronic media.  | 2 |
| Outcome 3.6 - Recognize changing technologies and make informed choices about their appropriateness and use.   | 3 |
| <b>Standard 4 - Oral Communication</b>   |   |
| Practice ethical and responsible oral communications appropriately to a variety of audiences and purposes.   |   |
| Outcome 4.1 - Identify and analyze the audience and purpose of any intended communication.   | 0 |
| Outcome 4.2 - Gather, evaluate, select, and organize information for the communication.  | 1 |
| Outcome 4.3 - Use language, techniques, and strategies appropriate to the audience and occasion.   | 1 |
| Outcome 4.4 - Speak clearly and confidently, using the voice, volume, tone, and articulation appropriate to the audience and occasion.                 | 2 |
| Outcome 4.5 - Summarize, analyze, and evaluate oral communications and ask coherent questions as needed.   | 1 |
| Outcome 4.6 - Use competent oral expression to initiate and sustain discussions.   | 2 |
| <b>Standard 5 - Critical Thinking</b>  |   |
| Apply critical thinking skills to effectively address the challenges and solve problems.   |   |
| Outcome 5.1 - Identify and state problems, issues, arguments, and questions contained in a body of information.  | 1 |
| Outcome 5.2 - Identify and analyze assumptions and underlying points of view relating to an issue or problem.  | 1 |
| Outcome 5.3 - Formulate research questions that require descriptive and explanatory analyses.  | 0 |

|   |   |
|---|---|
| <b>Outcome 5.4 - Recognize and understand multiple modes of inquiry, including investigative methods based on observation and analysis.</b>   | 1 |
| <b>Outcome 5.5 - Evaluate a problem, distinguishing between relevant and irrelevant facts, opinions, assumptions, issues, values, and biases through the use of appropriate evidence.</b> | 0 |
| <b>Outcome 5.6 - Apply problem-solving techniques and skills, including the rules of logic and logical sequence.</b>  | 3 |
| <b>Outcome 5.7 - Synthesize information from various sources, drawing appropriate conclusions.</b>  | 1 |
| <b>Outcome 5.8 - Communicate clearly and concisely the methods and results of logical reasoning.</b>  | 0 |
| <b>Outcome 5.9 - Reflect upon and evaluate their thought processes, value system, and world views in comparison to those of others.</b>   | 0 |
| <b>Standard 6 - Creativity</b><br><b>Able to express originality through a variety of forms.</b>  |   |
| <b>Outcome 6.1: Generate responses to problems and challenges through intuition and non-linear thinking.</b>  | 2 |
| <b>Outcome 6.2: Explore diverse approaches to solving a problem or addressing a challenge.</b>  | 2 |
| <b>Outcome 6.3: Sustain engagement in activities without a preconceived purpose.</b>  | 0 |
| <b>Outcome 6.4: Apply creative principles to discover and express new ideas.</b>  | 0 |
| <b>Outcome 6.5: Demonstrate the ability to trust and follow one's instincts in the absence of external direction</b>  | 0 |
| <b>Outcome 6.6: Build upon or adapt the ideas of others to create novel expressions or new solutions.</b>   | 0 |

### 33. Additional Information