Western Engineering

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ECE 4436A – Networking: Principles, Protocols and Architecture

Course Outline Fall 2025

COURSE DESCRIPTION:

This course introduces the fundamental concepts of communication networks. Specifically, it is concerned with network architectures and protocols. The objective of the course is to allow students to develop a thorough understanding of the architectures of networks and the basic principles that allow the transmission of data over the networks.

ACADEMIC CALENDAR:

https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_015751_1&SelectedCalendar=Live&ArchiveID=

Introduction to networking, network architecture and protocols, layering, OSI and TCP/IP models. Physical layer: transmission media, data encoding, Asynchronous and synchronous transmission. Data link layer: error detection, flow control, error control. Packet Switching: datagrams, virtual circuits, routing, congestion control, internetworking. Local area networks, network layer and transport layer.

PRE OR COREQUISITES:

Engineering Science 1036A/B or Computer Science 1026A/B.

Restricted to year 4 Electrical or Integrated or year 3 Software or year 3 or 4 Computer Engineering students.
Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

ANTIREQUISITES:

Computer Science 3357A/B.

CEAB ACADEMIC UNITS:

Engineering Science 75%, Engineering Design 25%

CONTACT HOURS:

LECTURE:	3hrs per week during the term
LABORATORY:	2hrs per week during the term

REQUIRED TEXT:

- James F. Kurose & Keith W. Ross, Computer Networking: A Top-Down Approach, Pearson, 8th Edition, ISBN-13: 9780135928615, 2020.

RECOMMENDED REFERENCES:

- Andrew S. Tanenbaum and David J. Wetherall, Computer Networks (5th Edition), Prentice Hall, 2010
- Kevin R. Fall and W. Richard Stevens, TCP/IP Illustated, Volume 1: The Protocols, Addison–Wesley, 2011
- W. Stallings, Data and Computer Communications, Prentice Hall, 2002.

RECOMMENDED SOFTWARE:

- **Mininet** is a network emulator that allows you to create a virtual network on a single machine, complete with hosts, switches, routers, and links. It's widely used for testing and developing OpenFlow-based SDN (Software-Defined Networking) applications in a scalable and flexible environment. It can be downloaded from https://mininet.org/
- **Wireshark** is a network protocol analyzer that captures and displays data packets in real-time. It allows users to inspect the details of network traffic for troubleshooting, analysis, and development. It can be downloaded from https://www.wireshark.org/
- **Oracle VirtualBox or Docker** will be used to run Mininet and Wireshark in a simulation environment. This allows students to create and manage isolated virtual networks for testing and analysis. VirtualBox provides full-fledged virtual machines, while Docker offers lightweight containers. Both enable efficient setup and testing of network configurations and traffic monitoring in a controlled environment.

GENERAL LEARNING OBJECTIVES (CEAB GRADUATE ATTRIBUTES):

Knowledge Base	A	**Engineering Tools**	A	**Impact on Society**	
Problem Analysis	D	**Individual & Team Work**	A	**Ethics and Equity**	
Investigation	D	**Communication**		**Economics and Project Management**	
Design	D	**Professionalism**		**Life-Long Learning**	

Notation: x represents the content level code as defined by the CEAB. blank = not applicable; I = introduced (introductory); D = developed (intermediate) and A = applied (advanced).

Rating: I – The instructor will introduce the topic at the level required. It is not necessary for the student to have seen the material before. D – There may be a reminder or review, but the student is expected to have seen and been tested on the material before taking the course. A – It is expected that the student can apply the knowledge without prompting (e. g. no review).

COURSE MATERIALS:

Weekly content and guides for the laboratories will be available on the course OWL site. The material for this course will be taught in both lectures and labs; therefore, it is imperative that you attend each lecture and lab.

COURSE TOPICS AND SPECIFIC LEARNING OUTCOMES:

The following table summarizes the course learning outcomes along with CEAB GAIs where the GAIs in bold indicate ones to be measured and reported annually.

Course Objectives and Specific Learning Outcomes	CEAB GA Indicators	Tentative Timeline
Chapter 1: Computer Networks and the Internet **At the end of this chapter, the students will be able to:**		
a. Demonstrate an understanding of the Internet.	**Taught but not assessed**	Week 1-2
b. Demonstrate knowledge of the Network Edge.		
c. Demonstrate knowledge of the Network Core.		
d. Demonstrate knowledge of the Network Access and Physical Media.		
e. Demonstrate an understanding of ISPs and Internet Backbones.		
f. Demonstrate an understanding of Delay and Loss in Packet-Switched Networks.		
g. Demonstrate an understanding of Protocol Layers and Their Service Models.		

Chapter 2: Application Layer At the end of this chapter, the students will be able to:		
a. Demonstrate an understanding of the Principles of Application Layer Protocols.	**KB4 I1 PA2 PA3 D2 D3 D4 ET2 ET3**	Week 3-4
b. Demonstrate an understanding of the Web, HTTP, FTP, DNS, and DNS-The Internet's Directory Service protocols.		
c. Understand and apply Socket Programming with TCP.		
d. Understand and apply Socket Programming with UDP.		
e. Design and build a Simple Web Server.		
f. Demonstrate an understanding of Content Distribution.		
Chapter 3: Transport Layer At the end of this chapter, the students will be able to:		
a. Demonstrate an understanding of Transport-Layer Services.	**KB4 I1 PA2 PA3 D2 D3 D4 ET2 ET3**	Week 5-6
b. Demonstrate an understanding of Multiplexing and De-multiplexing.		
c. Demonstrate an understanding of Connectionless Transport: UDP.		
d. Demonstrate an understanding of the Principles of Reliable Data Transfer.		
e. Build and apply the Principles of Reliable Data Transfer.		
f. Demonstrate an understanding of Connection-Oriented Transport: TCP.		
g. Design and apply the Principles of Congestion Control.		
h. Demonstrate an understanding of TCP Congestion Control.		
Chapter 4: Networking Layer and Routing Protocols At the end of this chapter, the students will be able to:		
a. Demonstrate an understanding of Network Service Model.	**KB4 I1 PA2 PA3 D2 D3 D4 ET2 ET3 ITW3**	Week 7-8
b. Build and apply the Routing Principles.		
c. Demonstrate an understanding of Hierarchical Routing.		
d. Demonstrate an understanding of The Internet Protocol.		
e. Demonstrate an understanding of Routing and the Internet.		
f. Demonstrate an understanding of what's Inside a Router.		
g. Demonstrate an understanding of IPv6.		
h. Demonstrate an understanding of Multicast Routing.		
i. Demonstrate an understanding of Mobility and the Network Layer.		
j. Demonstrate an understanding of Software Defined Networking (SDN).		
k. Demonstrate an understanding of Simple Network Management Protocol (SNMP).		

--- Reading Week ---		
Chapter 5: Link Layer Services and Protocols At the end of this chapter, the students will be able to:		
a. Demonstrate an understanding of Data Link Layer Services.	**KB4 I1 PA2 PA3 D2 D3 D4 ET2 ET3 ITW3**	Week 10-11
b. Demonstrate an understanding of Multiple Access Protocols.		
c. Demonstrate an understanding of LAN Addresses and ARP.		
d. Demonstrate an understanding of Ethernet.		
e. Demonstrate an understanding of Hubs, Bridges and Switches functionalities.		
f. Design and build Local Area Networks.		
g. Design and build Wireless Local Area Networks.		
h. Demonstrate an understanding of PPP: The Point-to-Point Protocol.		
i. Demonstrate an understanding of Data Centre Networking.		
Chapter 6: Cloud Networking Principles At the end of this chapter, the students will be able to:		
a. Demonstrate an understanding of data center network stack specifics	**KB4 I1 PA2 PA3**	Week 12
b. Demonstrate an understanding of management and sharing of network infrastructure in cloud data centers.		
c. Demonstrate an understanding of inter-data center WAN connectivity		
Chapter 7: Wireless Communications & Mobility At the end of this chapter, the students will be able to:		
a. Demonstrate an understanding of Wireless communications and Mobility.	**KB4 I1 PA2 PA3 ET2 ET3**	Week 13
b. Build and design of Wi-fi networks.		

EVALUATION:

Name	% Worth	Assigned	Due Date	CEAB GAs ASSESSED
Individual Lab Oral Exams (3)	30%	No	Posted on OWL	**KB4 I1 PA2 PA3 D2 D3 D4 ET2 ET3 ITW3**
Midterm Exam	30%	No	Posted on OWL	**KB4 I1 PA2 PA3 D2 D3 D4 ET2 ET3 ITW3**
Final Exam	40%	Yes	Final Exam Period	**KB4 I1 PA2 PA3 D2 D3 D4 ET2 ET3 ITW3**

Note that the dates listed above are tentative and may be adjusted if needed. Marks will be assigned on the basis of method of analysis and presentation, correctness of solution, clarity and neatness.

For this course, the following assessment has been designated as requiring supporting documentation:

- Final Exam, due during the final examination period

COURSE POLICIES:

Laboratory:
There will be three laboratory assignments, each spanning roughly three weeks and carrying equal weight toward the final grade. Laboratory work may be programming-based, and the Python programming language will be used. Instead of submitting written lab reports, each assignment will conclude with an individual oral exam.

- Every student will be assigned a specific time slot during their enrolled lab session for the oral exam.
- Attendance at the scheduled oral exam time is mandatory. **A missed exam will result in a grade of zero**, unless formal academic consideration is approved in advance or appropriate documentation is provided for an emergency.
- Students who receive approved academic consideration must contact the TA and instructor **within 24 hours** of the missed exam to arrange a make-up.

Self-Reported Absence:
No weight-shifting is allowed for self-reported absence; missed work will be due after a covered period.

Midterm Test:
There will be one midterm test, which will be a closed-book exam (no reference materials allowed) and will last for two hours. Calculators are not permitted. If a student misses the midterm, the exam will not be rescheduled. Instead, the weight of the midterm will be added to the final exam, making the final exam worth 70% of the overall grade. If no valid justification is provided for missing the midterm, the student will receive a mark of zero for the test.

Final Examination:
Please note that the final exam is considered to be central to the learning objectives for this course. Accordingly, students seeking academic consideration for this assessment must provide formal supporting documentation. Students who are granted academic consideration for this assessment will be provided with the following opportunity to make up this work: The final examination will take place during the regular examination period. It will be three hours long, closed book, and no calculators are allowed.
A mark of 60% or more must be achieved on the final examination to obtain a passing grade in the course. A final examination mark < 60% will result in a final course grade of 48% or less.
If the above conditions are not met, your final grade cannot exceed 48%. Students who have failed this course (i.e., final average < 50%) must repeat all course components.

Use of English:
In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance:
Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the department, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

ABSENCE FROM MANDATORY COURSE COMMITMENTS:

Students must familiarize themselves with the Policy on **Academic Consideration for Absences:** https://www.eng.uwo.ca/undergraduate/academic-consideration-for-absences.html

I. Missed/Late Accommodation Policy

1. Students missing a test/assignment/lab or examination you will report the absence by submitting Academic Consideration Request form through STUDENT ABSENCE PORTAL.
2. Documentation must be provided as soon as possible.
3. Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence.

II. Exam Accommodation

1. If you are unable to write a final examination, report your absence using the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). **The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.**
3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department and the Associate Dean and in order to apply you must submit an the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
   PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

III. LATE ASSIGNMENTS

IV. Medical Accommodation

1. Requests for Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
2. Requests for academic consideration must include the following components:
   a. Self-attestation signed by the student (*This is only accepted for the first/one absence*)
   b. Medical note. Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence.
   c. Indication of the course(s) and assessment(s) affected by the request
   d. Supporting documentation as relevant
3. Requests without supporting documentation are limited to one per term per course.
4. **Students must request academic consideration as soon as possible and no later than 48 hours after the missed assessment.**
5. Once the request and supporting documents have been received and reviewed, appropriate academic consideration, if granted, shall be determined by the instructor in consultation with the academic advisor, in a manner consistent with the course outline.

   Academic consideration may include extension of deadlines, waiver of attendance requirements for classes/labs/tutorials, or re-weighting of course requirements. Some forms of academic consideration, such as arranging Special Examinations, assigning a grade of Incomplete, or granting late withdrawals

without academic penalty, may only be granted by the Academic Advising office of the Faculty of Registration.

6. **An instructor may deny academic consideration for any assessment that is not required in the calculation of the final grade** (e.g., "8 of 10 quizzes"). Assessment flexibility must be indicated on the course outline.
7. **An instructor may deny academic consideration relating to the timeframe submission of work where there is already flexibility in the submissiontimeframe** (e.g., 72-hour submission window). This assessment flexibility must be indicated on the course outline.

V. Religious Accommodation

When scheduling unavoidably conflicts with religious holidays, which (a) require an absence from the University or (b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate Department Chair and, if necessary, the student's Dean.

It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action.

VI. Academic Integrity

In the Faculty of Engineering, we encourage students to create a culture of honesty, trust, fairness, respect, responsibility, and courage, befitting the professional degree you are pursuing.

Please visit Academic Integrity Western Engineering for more information

VII. Academic Offences

Plagiarism means using another's work without giving credit. The university has rules against plagiarism and other scholastic offences. Western Engineering has a zero-tolerance policy on plagiarism. The minimum penalty is zero on the course work and a repeat offence will earn you zero on the course. A third offence may lead to expulsion from the university.
Scholastic Discipline for Undergraduate Students & Cheating, Plagiarism and Unauthorized Collaboration: What Students Need to Know

Students must write their reports, essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (http://www.turnitin.com). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

VIII. Faculty of Engineering AI Policy

The use of generative Artificial intelligence (GenAI) tools won't be discouraged in the Faculty of Engineering. As we pride ourselves on building the future we can't hide from the use of GenAI tools to contribute to the understanding of the course materials. However, the use of GenAI tools in any assignment or contribution during the course will have to be disclosed, as a resource.

GenAI tools use won't be permitted in any type of examination or other assessments where the faculty have prohibited their use. If use of GenAI tools is detected by the instructor in these instances, academic offences penalties might be imposed against the student.

IX. Use of English Policy

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work except for the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

X. Accessibility

Western is committed to achieving barrier free accessibility for persons with disabilities studying, visiting and working at Western. As part of this commitment, there are a variety of services, groups and committees on campus devoted to promoting accessibility and to ensuring that individuals have equitable access to services and facilities. To help provide the best experience to all members of the campus community, please visit the Accessibility Western University for information on accessibility-related resources available at Western.

Students with disabilities may arrange for academic accommodation at Western. For a more detailed explanation, please visit Academic Support & Engagement -Academic Accommodation.

XI. Inclusivity, Diversity, and Respect

The Faculty of Engineering at Western University is committed to creating equitable and inclusive learning environments that value diverse perspectives and experiences. We recognize that university courses often marginalize students based on social identity characteristics such as, but not limited to, Indigeneity, race, ethnicity, nationality, ability, gender identity, gender expression, sexuality, age, language, religion, and socioeconomic status. Understanding this, we strive to facilitate equitable experiences and inclusion within the classroom by respecting and integrating multiple ways of knowing, being, and doing. Please visit the Office of Equity, Diversity and Inclusion.

XII. Health and Well-Being

- Health & Wellness Services – Students - Offers appointment-based medical clinic for all registered part-time and full-time students.
- Mental Health Support - Provides professional and confidential services, free of charge, to students needing assistance to meet their personal, social and academic goals. Services include consultation, referral, groups and workshops, as well as brief, change-oriented psychotherapy.
- Crisis Support - For immediate assistant, please visit Thames Hall Room 2170 or call 519-661-3030. The crisis clinic operates between 11:00 am - 4:30 pm. For after-hours crisis support, click here.
- Gender-Based Violence and Survivor Support - Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, here. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Important Contacts

Engineering Undergraduate Services	SEB 2097	519-661-2130	engugrad@uwo.ca
Electrical and Computer Engineering	TEB 279	519-661-2111 x86264	eceugrad@uwo.ca

Office of the Registrar/Student Central WSSB 1120 519-661-2100

Important Links

- WESTERN ACADEMIC CALENDAR
- ACADEMIC RIGHTS AND RESPONSIBILITIES
- ENGINEERING PROGRESSION REQUIREMENTS AND ACADEMIC REGULATIONS
- UNIVERSITY STUDENTS' COUNCIL (USC) - SERVICES
- IMPORTANT DATES AND DEADLINES
- ACADEMIC CONSIDERATION FOR MEDICAL ILLNESS - UNDERGRADUATE STUDENTS
- ACCOMMODATIONS FOR RELIGIOUS HOLIDAYS
- SCHEDULING OF ASSIGNMENTS, TESTS, AND EXAMINATIONS
- STUDENT FORMS
- OFFICE OF THE REGISTRAR
- RETENTION OF ELECTRONIC VERSION OF COURSE OUTLINES (SYLLABI)
- ACADEMIC APPEALS
- STUDENT ABSENCE PORTAL