

COMPENG 4DK4
Computer Communication Networks

Course Outline

(Please see the course web site for the latest version of this outline.)

CALENDAR/COURSE DESCRIPTION

Introduction to switching and communication networks; packet switching; shared media access and LANs; error control; network layer operation and the Internet; ISDN; wireless networks; performance and simulation.

This course introduces the design and operation of modern packet-switched computer networks such as the Internet. A variety of important material is covered, including techniques for automatic error control, shared media access control in wired and wireless networks, and the design and performance of the Internet. The course discusses the design of these systems including those factors that affect their performance. The laboratory component introduces discrete-event simulation of computer networks using the C programming language. The simulations are used to characterize the performance of various network related systems.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): Registration in Level III or greater in any Computer Engineering or Electrical Engineering Program; ELECENG 3TQ3.

SCHEDULE

Lectures: Mondays and Wednesdays: 8:30 am – 9:20 am. Fridays: 10:30 am – 11:20 am.

Tutorial: Tuesdays: 8:30 am – 9:20 am.

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Terry Todd
ITB-A324
todd@mcmaster.ca
ext. 24343

Office Hours: Please contact me directly via email.

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Names and contact information are provided on the course website.

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

<http://avenue.mcmaster.ca>

COURSE OBJECTIVES

By the end of this course, students should be able to demonstrate their competency and be knowledgeable on the following subjects and topics:

Introduction to communication networks.

Message Switching: Telegraphy and long distance communications, optical telegraphy, electronic telegraphy, message switching properties.

Circuit Switching: The telephone network, central switching, analog voice switching, crossbar switches, blocking vs non-blocking, multistage switches, digital voice transmission, digital voice switching, The time-slot-interchanger (TSI), time-division switching, time-multiplexed space-division switching, digital switching using TSIs and TMSs, circuit switching for computer traffic, properties of circuit switching, circuit switch timing.

Packet Switched Networks: Circuit vs packet switching, datagram and virtual circuit packet switching, layered protocol architecture, the Open Systems Interconnection (OSI) Reference Model, connection vs connection-less services and protocols.

Error Control Protocols: Forward error correction, ARQ, alternating bit protocols, ABP performance under noiseless and noisy channels, sliding window protocols, selective repeat protocols. SR protocol performance over error-free and noisy channels, GO-BACK-N protocols, performance of GO-BACK-N, the use of ARQ protocols at the transport layer, TCP.

Multi-access Communication and Local Area Networks: Media access control, TDMA, FDMA and CDMA, random access networks, ALOHA (slotted and unslotted), throughput analysis, stability considerations, control algorithms for stability, CSMA, performance analysis, Local Area Networks (LANs), IEEE 802 standard LANs, CSMA/CD, Ethernet, capacity limitations, token ring networks, performance of ring networks, bridging.

Network Layer Communications and the Internet: Routing algorithms, shortest path routing, Bellman-Ford Distance Vector routing, RIP, link state routing, OSPF, hierarchical routing, Internet routing, address structure, subnetting, ARP.

Wireless Networking (time permitting): Wireless propagation, cellular network design, cellular geometry and interference-limited channel assignment, mobility management in cellular

networks, wireless media access, hidden and exposed CSMA stations, IEEE 802.11 wireless LAN, frequency-hopping air interfaces, Bluetooth.

Communication Network Simulation: Discrete-event simulation, simulation using the Simlib library, application to various networking systems.

CEAB GRADUATE ATTRIBUTES

Note: *Learning Outcomes* are measured throughout the course and form part of the Department's continuous improvement process. They are a key component of the accreditation process for the program and will not be taken into consideration in determining a student's actual grade in the course. For more information on accreditation, please ask your instructor or visit: <http://www.engineerscanada.ca> .

Outcomes	Indicators	Measurement Method(s)
Identifies and states reasonable assumptions and suitable engineering fundamentals, before proposing a solution path to a problem.	2.1	Final exam, midterm test or Labs.
Proposes problem solutions supported by substantiated reasoning, recognizing the limitations of the solutions.	2.2	Final exam, midterm test or Labs.
Selects appropriately from relevant knowledge base to plan appropriate data collection methods and analysis strategies.	3.1	Final exam, midterm test or Labs.
Defines the problem by identifying relevant context, constraints, and prior approaches before exploring potential design solutions.	4.1	Final exam, midterm test or Labs.
Justifies and reflects on design decisions, giving consideration to limitations, assumptions, constraints and other relevant factors.	4.4	Final exam, midterm test or Labs.

ASSUMED KNOWLEDGE

ELECENG 3TQ3

COURSE MATERIALS

Required Texts:

Communication Networks (Second Edition), A. Leon-Garcia and I. Widjaja, McGraw-Hill, 2004.

Other Materials:

Personal Computer or laptop with a C compiler.

COURSE OVERVIEW

Date/Week	Topic	Readings
1	Introduction To Communication Networks	Chs. 1, 3 in textbook, lecture notes.
1	Message Switching	Ch. 2 in textbook, lecture notes.
2	Circuit Switching	Ch. 4 in textbook, lecture notes.
3	Packet Switched Networks	Ch. 2 in textbook, lecture notes.
5	Error Control Protocols	Ch. 5 in textbook, lecture notes.
8	Multi-access Communication and Local Area Networks	Ch. 6 in textbook, lecture notes.
10	Network Layer Communications and the Internet	Chs. 7, 8 in textbook, lecture notes.
11	Wireless Networking Communication Network Simulation	Lecture notes. Lecture notes.

At certain points in the course it may make good sense to modify the schedule. The instructor may modify elements of the course and will notify students accordingly (in class, on the course website).

LABORATORY OVERVIEW

Date/Week	Topic	Readings
2	Performance of Single Server Queueing Systems	See course web site.
5	Packet Switched Network and Integrated Voice Performance	See course web site.
8	Call Blocking in Circuit Switched Networks	See course web site.
11	The ALOHA Media Access Control Protocol	See course web site.

LABORATORY OPERATION

- Each student in the course is required to pass the lab safety quiz prior to attempting any of the laboratories. The quiz will be available on Avenue to Learn.

- Access to all labs is restricted in the interest of security and safety. Information on accessing and using the lab can be found on this webpage:
<https://www.eng.mcmaster.ca/ece/labs-and-health-safety#Labs-Access-and-Use>
- Lab Experiments: Every student conducts the lab experiment individually or in their lab group at home.
- Lab Requirements: Students need to submit their experiment results on Avenue to Learn on the due date described in the lab manual. No late submission will be accepted.

ASSESSMENT

Component	Weight
Laboratories	30%
Midterm	0% or 30% (see below)
Final Exam	70% or 40% (see below)
Total	100%

30% of the mark is taken as the best of the midterm and final exam.

Grading and Evaluation Policies:

- There are four (4) labs, one (1) mid-term test, and one (1) final exam.
- There is no make-up/deferred mid-term test. The weight of a missed midterm test will be transferred to the final exam.
- Late submissions of lab reports are subject to a 20% penalty per day (less than one day is counted as one day).
- When an MSAF is filed for a lab writeup deadline, the submission deadline will be automatically set 3 days beyond the date of the MSAF.
- Deferred final exams may be oral.

Electrical and Computer Engineering Lab Safety

Information for Laboratory Safety and Important Contacts

This document provides important information for the healthy and safe operation of ECE instructional laboratories. This document is required reading for all laboratory supervisors, instructors, researchers, staff, and students working in or managing instructional laboratories in ECE. It is expected that revisions and updates to this document will be done continually. A

McMaster University lab manual is also available to read in every laboratory and online <https://hr.mcmaster.ca/app/uploads/2019/07/2019-McMaster-Lab-Manual.pdf>

General Health and Safety Principles

Good laboratory practice requires that every laboratory worker and supervisor observe the following whether conducting lab work at school or at home:

1. Food and beverages are not permitted in the instructional laboratories.
2. A Laboratory Information Sheet on each lab door identifying potential hazards and emergency contact names should be known.
3. Laboratory equipment should only be used for its designed purpose.
4. Proper and safe use of lab equipment should be known before using it.
5. The course TA leading the lab should be informed of any unsafe condition.
6. The location and correct use of all available safety equipment should be known.
7. Potential hazards and appropriate safety precautions should be determined, and sufficiency of existing safety equipment should be confirmed before beginning new operations.
8. Proper waste disposal procedures should be followed.
9. Personal ergonomics should be practiced when conducting lab work. <https://bit.ly/3fOE71E>
10. Current University health and safety issues, and protocol should be known. <https://hr.mcmaster.ca/resources/covid19/workplace-health-and-safety-guidance-during-covid-19/>

Location of Safety Equipment

Fire Extinguisher

On walls in halls outside of labs

First Aid Kit

ITB A111, or dial “88” after 4:30 p.m.

Telephone

On the wall of every lab near the door

Fire Alarm Pulls

Near all building exit doors on all floors

Who to Contact

Emergency Medical / Security: On McMaster University campus, call Security at extension **88** or **905-522-4135** from a cell phone.

Non-Emergency Accident or Incident: Immediately inform the TA on duty or Course Instructor.

University Security (Enquiries / Non-Emergency): Dial 24281 on a McMaster phone or dial 905-525-9140 ext. 24281 from a cell phone.

See TA or Instructor: For problems with heat, ventilation, fire extinguishers, or immediate repairs

Environmental & Occupational Health Support Services (EOHSS): For health and safety questions dial 24352 on a McMaster phone or dial 905-525-9140 ext. 24352 from a cell phone.

ECE Specific Instructional Laboratory Concerns: For non-emergency questions specific to the ECE laboratories, please contact 24103.

In Case of a Fire (On Campus Dial 88)

When calling to report a fire, give name, exact location, and building.

1. Immediately vacate the building via the nearest Exit Route. Do not use elevators!
2. Everyone is responsible for knowing the location of the nearest fire extinguisher, the fire alarm, and the nearest fire escape.
3. The safety of all people in the vicinity of a fire is of foremost importance. But do not endanger yourself!
4. In the event of a fire in your work area shout "*Fire!*" and pull the nearest fire alarm.
5. Do not attempt to extinguish a fire unless you are confident it can be done in a prompt and safe manner utilizing a hand-held fire extinguisher. Use the appropriate fire extinguisher for the specific type of fire. Most labs are equipped with Class A, B, and C extinguishers. Do not attempt to extinguish Class D fires which involve combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium, and any other finely divided metals which are oxidizable. Use a fire sand bucket for Class D fires.
6. Do not attempt to fight a major fire on your own.
7. If possible, make sure the room is evacuated; close but do not lock the door and safely exit the building.

Clothing on Fire

Do not use a fire extinguisher on people

1. Douse with water from safety shower immediately or
2. Roll on floor and scream for help or
3. Wrap with fire blanket to smother flame (a coat or other nonflammable fiber may be used if blanket is unavailable). Do not wrap a standing person; rather, lay the victim down to extinguish the fire. The blanket should be removed once the fire is out to disperse the heat.

Equipment Failure or Hazard

Failure of equipment may be indicative of a safety hazard - You must report all incidents.

Should you observe excessive heat, excessive noise, damage, and/or abnormal behaviour of the lab equipment:

1. Immediately discontinue use of the equipment.
2. In power labs, press wall-mounted emergency shut-off button.
3. Inform your TA of the problem.
4. Wait for further instructions from your TA.
5. TA must file an incident report.

Protocol For Safe Laboratory Practice

Leave equipment in a safe state for the next person - if you're not sure, ask!

In general, leave equipment in a safe state when you finish with it. When in doubt, consult the course TA.

Defined Roles

TA	The first point of contact for lab supervision	
ECE Lab Supervisor	Steve Spencer- ITB 147	steve@mail.ece.mcmaster.ca
ECE Chair	Mohamed Bakr - ITB A111	mbakr@mcmaster.ca
ECE Administrator	Shelby Gaudrault - ITB A111	gaudraus@mcmaster.ca
ECE Course Instructor	Please contact your course instructor directly	