COMP ENG 4DK4
Computer Communication Networks

Fall 2017
Course Outline
(Please see the course web site for the latest version of this outline.)

CALENDAR/COURSE DESCRIPTION

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 3TQ4

SCHEDULE

Lectures: Monday, Wednesday and Thursday in T13/127 at 1:30 pm – 2:20 pm
Tutorial: Tuesday in T13/127 at 1:30 pm – 2:20 pm
Labs: Tuesdays ETB/119, Wednesdays JHE/329, Thursdays TSH/B126 and Fridays ETB/119 at 2:30pm – 5pm (Alternate weeks starting the week of Sept 11.)

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

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

Office Hours: After class at 2:30 pm Monday, Wednesday and Thursday. Please contact me during class or by email beforehand.

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Peyvand Teymoori
ITB/A302
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905-525-9140 ext. 27264

Arvin Hekmati
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Keyvan Mohammadi
ITB/A102
mohamk8@mcmaster.ca
905-525-9140 ext. 22009

Office Hours:
TBA

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

https://owl.ece.mcmaster.ca/coe4dk4

COURSE OBJECTIVES

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.

ASSUMED KNOWLEDGE

ELECENG 3TQ4

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

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.
13	Scheduling for Mobile Cloud Computation Offloading	See course web site.

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 exam as indicated above.

ACCREDITATION LEARNING OUTCOMES

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 Methods
Constructs effective oral or written arguments as appropriate to the circumstances: Summarize the operation, properties, and performance, of message switched networks. Understand the functioning of circuit switched networks including a quantitative understanding of their blocking performance behaviour. The tradeoffs between circuit and packet switched network operation and an understanding of layered protocol design used in packet switched networks.	7.3	Final exam.
Obtains substantiated conclusions as a result of a problem solution including recognizing the limitations of the solutions: Understand the use and performance of common packet switched error control methods, i.e., automatic repeat request (ARQ) protocols. Understand the operation and performance of media access control in packet switched networks with shared channels, e.g., static channelization, random access, and reservation protocols.	2.2	Final exam.
Recognizes and discusses applicable theory knowledge base: Understanding of network layer communications, i.e., routing	3.1	Final exam.

algorithms, such as distance vector and link state routing.		
Determines and employs applicable standards and codes of practice.	4.6	Final exam.
Working knowledge of IP routing in the Internet, i.e., address structure, subnetting, ARP.		
Problem Analysis – Ability to obtain substantiated conclusions as a result of a problem solution including recognizing the limitations of the solutions:	2.2	Final exam.
Understanding of discrete-event simulation (using the C programming language) and its use to understand the performance of queueing systems and computer networks.		

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at http://www.mcmaster.ca/academicintegrity

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

ACADEMIC ACCOMMODATIONS

Students who require academic accommodation must contact Student accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contact by phone at

905.525.9140 ext. 28652 or e-mail at sas@mcmaster.ca. For further information, consult McMaster University's Policy for Academic Accommodation of Students with Disabilities.

Notification of Student Absence and Submission of Request for Relief for Missed Academic Work

In the event of an absence for medical or other reasons, students must review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

Notice Regarding Possible Course Modification

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

Reference to Research Ethics

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to http://www.mcmaster.ca/policy/faculty/Conduct/ResearchEthicsPolicy.pdf.

Electrical and Computer Engineering Lab Safety

Information for Laboratory Safety and Important Contacts

This document is for users of ECE instructional laboratories in the Information Technology Building.

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.

General Health and Safety Principles

Good laboratory practice requires that every laboratory worker and supervisor observe the following:

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.

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.

In Case of a Fire (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 Lab, 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	Tim Davidson- ITB A111	davidson@mcmaster.ca
ECE Administrator	Kerri Hastings- ITB A111	hastings@mcmaster.ca
ECE Course Instructor	Please contact your specific course instructor directly	