

**COMP ENG 4DM4
Computer-Architecture**

COURSE OUTLINE

Please refer to course website for updated information.

COURSE DESCRIPTION

Overview of CISC/RISC microprocessors; performance metrics, instruction set design; processor and memory acceleration techniques; pipelining; scheduling; instruction level parallelism; memory hierarchies; multiprocessor structures; storage systems; interconnection networks.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): Registration in level III or IV in any Computer Engineering or Electrical Engineering Program, COMPENG 3DR4
Antirequisite(s): COMPSCI 2CA3, SFWRENG 3GO3, SFWRENG 3GA3

SCHEDULE

Lecture: Tuesday, Wednesday & Friday 9:30 AM – 10:30 AM
Tutorial: Wednesday 12:30 PM
Lab: (Every Other Week) Wednesday, Thursday & Friday 2:30 PM – 5:30 PM

INSTRUCTOR

Dr. Saneeha Ahmed
Email: ahmes92@mcmaster.ca
Office: ITB-A107
Office Hours: Fridays 11:00 AM to 1:00 PM

TEACHING ASSISTANTS

Names, contact information and office hours are provided on the course website.

COURSE WEBSITE/S

<http://avenue.mcmaster.ca>

COURSE OBJECTIVES

By the end of this course, students should have design exposure to:

- Hardware design, static and dynamic scheduling techniques
- Multicore processor systems (such as Intel Core i3, i5 and i7 processor family)
- Supercomputer and cloud data-center designs.

ASSUMED KNOWLEDGE

Computer Architecture 4DM4 is suitable for students having some exposure to introductory courses o Computer Architecture, digital logic and digital systems design

COURSE MATERIALS

Required Texts:

Computer Organization and design 5th Edition (or recent) by Petterson and Hennessy, Elsevier/ Morgan Kaufman ISBN 978-0-12-407726-3

Calculator:

Only the McMaster Standard Calculator (Casio fx-991 MS or MS Plus) will be permitted in tests and examinations. This is available at the Campus Store.

Other:

- Class Lecture Notes available at Avenue-to-Learn
- Reference book “ Computer Architecture: A Quantitative Approach”, 5th Edition by Hennessy and Patterson

COURSE OVERVIEW

Week	Topic	Readings
1	Intro to Computing, Moore’s law, Intro to VHDL programming	lecture notes
2	Intro to VHDL Programming, switches in VHDL, Review assignment on Super Computers/ Data centers	lecture notes
3	Review 5- stage pipelined processor, pipeline hazards, data forwarding, branch- stalls, exceptions	Text Ch. 6, lecture notes
4	Static Scheduling, loop unrolling, performance analysis, multiple issue, Review- Assignment-2 on Static Scheduling	Text Ch. 6, lecture notes
5	Itanium Static Scheduling, Max-Speed, Min Bundles	Text Ch. 6, lecture notes
6	Assignment Solutions and Sample Problems for Mid Term	Lecture notes
7	Mid-Term, Dynamic Scheduling, Register Renaming, Automatic loop unrolling, steady state performance	lecture notes, Text Ch.6, Ref. Ch. 3

8	Dynamic Scheduling: Non- Speculative vs Speculative Machines, Pentium Processors, ARM (Apple A8-A9) processors	lecture notes, Text Ch.6, Ref. Ch. 3
9	Multi threading: Intel Core i7 processor; Performance tables; Multithreading MULD example, Multithreading DIVD example	lecture notes, Text Ch.6, Ref. Ch. 3
10	Multi threading examples, Exascale Computing research, assignment	lecture notes
11	Class presentation and discussion on assignments	
12	Class presentation and discussion on assignments	
13	Class presentations, anything exciting in Computing	

A more detailed time line is available on the course web site.

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

Week	Topic
1	-Na--
2	Lab #1: Design a pipelined switch in VHDL for the Cyclone FPGA
3	Practice lab #1
4	Lab #1: demonstrations this week in lab room
5	Lab#2: Design a toroid network-on- chop (NOC) using switches from Lab#1
6	Practice lab#2
7	Work on lab on your own
8	Lab#2 demonstrations in lab room
9	Operational Lab3: Demonstrate multiprocessors using toroid NOC from Lab#2
10	Practice lab#3
11	Work on lab on your own
12	Work on lab on your own
13	Lab#3 demonstrations this week in lab room

LABORATORY OPERATION

- Labs will be conducted every other week in ITB-234
- All labs will be performed in groups of 2 to 3 students
- For the labs you will require Altera Quartus software. One final report report will be submitted by each group on the day of demonstration
- All groups should reserve their 10 minutes time slots. The reservation details will be provided online.
- Late submissions will cause the group to lose 10% marks per day.
- There will be Q & A after or during the demonstrations therefore students are required to come prepared.

ASSESSMENT

Component	Weight
Assignments	10 % (for all assignments)
Lab	10 % (for 2 labs)
Mid Term	20 %
Class presentations	5%
Final Exam	55 %
Total	100 %

- To pass the course, the student must pass the final exam. Students may be awarded bonus marks for class participation
- No makeup midterm tests will be granted. Weight of the missed exam will be transferred to the final exam. In case of an unavoidable situation please email the professor explaining the situation and provide documentary proof of emergency wherever applicable.

ACCREDITATION LEARNING OUTCOMES

Note: The *Learning Outcomes* defined in this section 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)
Capable of selecting appropriate model and methods and identify assumptions constraints	3.2 (Select model and methods)	Labs
Recognizes and follows an engineering design process (This means an iterative activity that might include recognizing the goal, specifying the constraints and desired outcomes, proposing solutions, evaluating alternatives, deciding on a solution, and implementing.)	4.1	Assignments
Demonstrate ability to respond to technical and non-technical instructions and questions.	7.1 (Communication Skills)	Class presentations
Understands the business processes for implementing engineering ideas	11.3 (Economics Project Management)	Assignment (Supercomputers/ Data centers)

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 www.mcmaster.ca/academicintegrity.

The following illustrates only three forms of academic dishonesty:

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

ACADEMIC ACCOMMODATIONS

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca. For further information, consult McMaster University's Academic Accommodation of Students with Disabilities policy.

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students requiring a RISO accommodation should submit their request to the Engineering Student Services office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations.

Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

STUDENT ABSENCE AND SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

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

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be

communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

AUTHENTICITY / PLAGIARISM DETECTION

In this course we will be using a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work.

Students will be expected to submit their work electronically either directly to Turnitin.com or via Avenue to Learn (A2L) plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish to submit their work through A2L and/or Turnitin.com must still submit an electronic and/or hardcopy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com or A2L. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). To see the Turnitin.com Policy, please go to www.mcmaster.ca/academicintegrity.

ONLINE ACCESS OR WORK

In this course we will be using email and Avenue-to-Learn. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure.

If you have any questions or concerns about such disclosure please discuss this with the course instructor.

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>.

www.eng.mcmaster.ca/ece

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.

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

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 Course Instructor	Saneeha Ahmed	ahmes92@mcmaster.ca
ECE Administrator	Kerri Hastings- ITB A111	hastings@mcmaster.ca
ECE Chair	Tim Davidson- ITB A111	davidson@mcmaster.ca