

Western University
Faculty of Engineering
Department of Electrical and Computer Engineering

ECE 3389A: Computer System Design

Course Outline 2023-2024

Description: The objective of this course is to expose the student core topics and techniques for the design or analysis of computer systems, from the constrained embedded microprocessors to the most powerful supercomputers. The topics begin with the fundamental and background material needed to understand the basic characteristics of a computer system with an overview of digital computer technology, and a detailed perspective on computer system performance. Then, main topics of Instruction Set Architecture (ISA), central processing unit (CPU), arithmetic/logic units (ALUs), memory hierarchy will be discussed. After establishing these fundamentals, the design of a simple processor and applying some techniques to increase its performance will be considered. Finally, the interface between high-level languages and hardware implementation is discussed, with a focus on CPU design features required to support high-level languages.

Academic Calendar Copy: Introduction to computer system design and the architecture of modern high-performance computers. Memory hierarchy. RISC, superscalar, and multi-core architectures. Microprogrammed and hardwired control implementations. Students will complete group design projects integrating these concepts.

Contact Hours: 3 lecture hours, 1.5 laboratory hours, 0.5 course

Antirequisite: The former ECE 4470A/B, the former ECE 4489A/B

Prerequisites: ECE 3375A/B and ECE 3380A/B, or completion of third year of the Software Engineering program.

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.

CEAB Academic Units: Engineering Science 75%, Engineering Design 25%.

Required Textbook: The course does not have a required textbook. From time to time, assigned readings may be assigned, which may include handouts or web references.

General Learning Objectives (CEAB Graduate Attributes)

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

Course Topics and Specific Learning Outcomes	CEAB Graduate Attributes Indicators
<p>1. Background and Motivation At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Understand the basic components used in building digital circuits and typical computer architectures b. Know an overview of computer technology 	KB.3
<p>2. Instruction Set Architecture At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Identify the trade-offs involved in designing an Instruction Set Architecture (ISA) b. Understand how machine language programs are executed 	KB.3
<p>3. Data Path and Control Units At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Design a simple computer b. Understand the distinction between the data path and the control logic in a computer or other complex digital system c. Be able to troubleshoot and debug complex digital systems 	D.1,D.4, I.1, I.2, ET.2, CS.1 KB.3
<p>4. Arithmetic Logic Units At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Distinguish between fixed- and floating-point numerical representations b. Understand design concepts for high-speed arithmetic circuits 	PA.1, PA.3
<p>5. Advanced CPU Architectures At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Understand the Reduced Instruction Set (RISC) computing philosophy and its performance advantages 	KB.3, PA.1, PA.3, ITW.2

<p>b. Understand the superscalar computing philosophy and its performance advantages</p>	
<p>6. Memory System Design At the end of this section, students will be able to:</p> <p>a. Understand the basic technology behind the implementation of major storage technologies (RAM, ROM, Flash, etc)</p> <p>b. Understand the concept of the memory hierarchy and why it is important for computer performance</p>	<p>KB.3 PA.3</p>
<p>7. CPU Implementation of High Level Language Computing At the end of this section, students will be able to:</p> <p>a. Understand the basics of compilation</p> <p>b. Understand how high-level language structures are implemented in machine language</p> <p>c. Understand how CPU structures support high-level language concepts such as subroutines, exceptions, data structures, etc.</p>	<p>D.1, D.4, I.1, ET.2, CS.1, PA.1, PA.2, PA.3</p>
<p>8. Performance Analysis At the end of this section, students will be able to:</p> <p>a. Identify Amdahl's Law for computer performance assessment</p> <p>b. Solve simple problems determining expected speed-up for proposed performance enhancements</p>	<p>KB.3, PA.1, PA.2, PA.3</p>

Evaluation

Course Component	Weight (A)	Weight (B)
Laboratory/Project	25%	25%
Midterm Test	20%	0%
Final Examination	55%	75%

Course final grade computation: Each student's course grade will be computed according to both listed weightings (A and B). The student will receive whichever computed grade is higher.

Laboratory: The Laboratory component of the course takes the part of a first (introductory) lab exercise, followed by a semester-long project. The project consists of a well-defined first part and an open-ended second part. Milestones will be spaced throughout the semester. Students are advised to make use of available laboratory time but laboratory attendance is not mandatory.

Midterm Test: A two-hour closed-book midterm test will take place during the regularly scheduled lecture. The test date will be announced in the course website on OWL. The examination is **closed book**, with no aids permitted (i.e. NO books, notes, calculators, or other information processing devices).

Final Examination: A three-hour closed-book final exam will be scheduled during the regular Fall term examination period in December. This examination is closed book, with no aids permitted (i.e. NO books, notes, calculators, or other information processing devices).

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.

Missed Midterm Examinations: We will not have make-up midterms. If you miss the midterm, the weight will be automatically shifted to the final examination in accordance with Weight (B).

Cheating and Plagiarism: Students must write their 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.

STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE

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.

INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

A. GENERAL REGULATIONS & PROCEDURES

1. All first-year students will report to the Undergraduate Services Office by submitting the [Academic Consideration Request Form](#), for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination you will report the absence by submitting [Academic Consideration Request Form](#). Absences worth LESS THAN 10% of your mark, will be processed by your department office. If your course work is worth 10% OR MORE of your final grade, your request will be processed by the Undergraduate Services Office.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.
5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM/MIDTERM TESTS

1. If you are in first year and you are unable to write a midterm/term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.
2. If you are an upper year student and you are unable to write a midterm/term test, inform your instructor PRIOR to the scheduled date of the test and request relief through the [Academic Consideration Request Form](#). If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, your request for relief will be processed by your department office. If the test is worth MORE THAN 10% of your final grade your request for relief will be processed by the Undergraduate Services Office.
3. Be prepared to attach supporting documentation to the Department Chair and/or the Undergraduate Services Office through the online form (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

C. FINAL EXAMINATIONS

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to report your absence using the [Academic Consideration Request Form](#) and request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.
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 "[Application for a Special Exam](#)" form. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

D. LATE ASSIGNMENTS

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
2. Be prepared to submit the [Academic Consideration Request Form](#) and provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4.
 - i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.
 - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your Academic Counsellor.

Calendar References: Check these regulations in your 2023 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness:

https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_13_5

Academic Accommodations for Students with Disabilities:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_10

Academic Accommodations for Religious or Holy Days:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_16

Course Withdrawals:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=6&SelectedCalendar=Live&ArchiveID=#Page_75

Examinations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5&command=showCategory&SelectedCalendar=Live&ArchiveID=#Page_78

Scheduling of Term Assignments:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_78

Scholastic Offences:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20

Student Medical Certificate:

<https://www.eng.uwo.ca/files/undergraduate/student-medical-certificate.pdf>

Engineering Academic Regulations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=4&SelectedCalendar=Live&ArchiveID=#Page_86

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

Add Deadlines:

First term half course (i.e. “A” or “F”)	September 15, 2023
Full courses and full-year half course (i.e. “E”, “Y” or no suffix)	September 15, 2023
Second term half course (i.e. “B” or “G”)	January 16, 2024

Drop Deadlines:

First term half course without penalty (i.e. “A” or “F”)	November 13, 2023
Full courses and full-year half courses without penalty (i.e. “E”, “Y” or no suffix)	November 30, 2023
Second term half or second term full course without penalty (i.e. “B” or “G”)	March 7, 2024

Contact Information:

Undergraduate Services Office:	SEB 2097 Phone: 519-661-2130	E-mail: engugrad@uwo.ca
Chemical & Green Process Engineering:	TEB 477 Phone: 519-661-2131	E-mail: cbeugrad@uwo.ca
Civil Engineering:	SEB 3005 Phone: 519-661-2139	E-mail: civil@uwo.ca
Computer, Electrical, Mechatronic Systems & Software Engineering	TEB 279 Phone: 519-661-3758	E-mail: eceugrad@uwo.ca
Integrated Engineering	ACEB 2410 Phone: 519-661-6725	E-mail: engceli@uwo.ca
Mechanical Engineering:	SEB 3002 Phone: 519-661-4122	E-mail: mmeundergraduate@uwo.ca