

# ELEC 8550-1 Computer Arithmetic

## Course Syllabus

**Faculty of Engineering, Department of Electrical and Computer Engineering  
University of Windsor, Canada**

Fall 2020

Please note: this syllabus will be reviewed during our first class meeting, and an electronic copy will be posted on the course website within Blackboard. It is subject to change, subject to bylaw provisions.

### Instructor information

- Name: Dr. Huapeng Wu
- Office: 3049 CEI
- Office Hours: 10:30am-12:30pm, Wednesday, on Microsoft Teams (tentative)
- Office Phone Number: 519-253-3000 x2568
- Email: hwu@uwindsor.ca
- Mailbox: departmental office
- Website: blackboard.uwindsor.ca

### Graduate Assistant (GA) information

Name	Office	Office Hours (and by appointment)	Office Phone Number (extension #)	Email (24hr response time Mon.-Fri.)	Mailbox
TBA					

### Class information

- Class Location: Blackboard virtual classroom (tentative)
- Class Time: 8:30am-9:50am, Tuesday and Thursday (the 1<sup>st</sup> class at 8:30am, Sept 10)
- Lecture: \_\_3\_\_ hours/week
- Credit Weight: 3
- Course format: online.

### Examinations

- Midterm: Date: Tuesday, Oct 20; open book
- Final Examination: Date: TBA.

### Resources

- Lecture notes (posted on course Blackboard site)
- Textbook (required)
  - Computer Arithmetic Algorithms, 2nd ed. (hardcover), by Israel Koren, A. K. Peters, Natick, MA, 2002. ISBN 1-56881-160-86
- Additional resources
  - Other reading materials posted on Blackboard site
- Web resources

- Keywords: computer arithmetic, number systems, arithmetic architecture

### **Course Description**

This course presents a detailed description of general class of fixed-radix number systems, floating-point representation, algorithms and architectures for sequential and fast computation of multiplication, division and square root extraction, elementary functions, logarithmic and residue number systems, finite field arithmetic operations, error control in arithmetic processors. Course assignments and mini-projects on practical aspects of the course are required.

#### **Pre-requisites**

- Graduate Student Status
- Substantial knowledge on digital logic design and computer architecture

### **Objective**

To let students have a solid understanding of the theories and the methodologies of efficient computations and architectures for various arithmetic operations. It is intended to be offered to the graduate students who will work in computer, communication, and DSP areas, although it is also beneficial to the students in electrical engineering and computer science in general.

### **Instructor's Policy on Recording Lectures**

Any recording of lectures or guest lecturer/classmate presentations by students can be used only for the purposes of private study by the individual student. The recording (including any transcriptions or any translation to any other form) cannot be shared, distributed, emailed, posted online or otherwise disseminated or communicated in any form or to any other person (including fellow classmates) unless written consent has first been obtained from the instructor or presenter.

Students who record a lecture after the instructor has prohibited such recordings, or who record a guest lecturer or classmate presentation or performance without the written consent of the presenter, or who disseminate a recording without the explicit written permission from the instructor or presenter will be subject to the University's misconduct policies, at minimum.

Where the recording captures the image of classroom activities (e.g., video-recording or other image-capture technology), such recording must only capture the instructor or the presenter within the classroom setting.

### **Intellectual Property**

Lectures and course materials prepared by the instructor are considered by the University to be an instructor's intellectual property covered by the Copyright Act, RSC 1985, c C-42. Course materials such as PowerPoint slides and lecture recordings are made available to you for your own study purposes. These materials cannot be shared outside of the class or "published" in any way. Posting recordings or slides to other websites without the express permission of the instructor will constitute copyright infringement.

### **Instructor-Student Agreement**

The instructor will strive to

- establish an educational environment conducive to learning,
- provide quality instruction, and
- provide differentiating assessment, *i.e.*, not every student deserves an A.

You, as a student in this class, will strive to

- prepare for class,
- attend class and engage in the teaching methods,
- complete the assigned work with integrity, and
- prepare for the tests.

### Course Schedule

The following course schedule is approximate.

Week	Date	Subject, activity, assignment, etc.	Textbook Chapter or Readings
1		Discussion on syllabus, Introduction to the course	Courseware
2		Chapter 1. Conventional number systems	Courseware
3		Chapter 2. Unconventional number systems	Courseware
4		Chapter 2. Unconventional number systems Chapter 3. Sequential algorithms for multiplication/division	Courseware
5		Chapter 3. Sequential algorithms for multiplication/division Chapter 4. Floating-point representations	Courseware
6		Chapter 4. Floating-point representations Chapter 5. Fast addition	Courseware
7		Chapter 5. Fast addition	Courseware
8		Chapter 5. Fast addition	Courseware
9		Chapter 6. High-speed multiplication	Courseware
10		Chapter 6. High-speed multiplication	Courseware
11		Chapter 7. Residue number system	Courseware
12		Chapter 7. Residue number system	Courseware

**Note:** Per University of Windsor Senate Bylaw 54,

“The last seven calendar days prior to, and including, the last day of classes in each period of instruction of twelve (or greater) weeks in duration must be free from any procedures for which a mark will be assigned, including the submission of assignments such as essays, term papers, and take home examinations. Courses that are presented by a specialized teaching method, where the testing procedures are an integral part of the instructional process, shall be exempt from this regulation subject to approval of the Dean of the Faculty in which the course is given.”

### Important Dates

September 23, 2020

The last date to **ADD/DROP** a course or change sections is two weeks after the start of classes for 12-week session courses

September 30, 2020	Last day for student to make a formal request to instructor(s) for <b>accommodation for missed mandatory academic events</b> (tests, midterms, labs) <b>due to Religious Observance or attendance at a recognized University-sponsored event</b> should be done within the first three weeks of the academic term. For 6 week course the deadline is end of the first week of classes.
October 31, 2020	<b>Application Deadline for Alternative Final Examination(s) Due to Conflict with Religious Conviction.</b>
October 31, 2020	<b>Application Deadline for Alternative Final Examination(s) Due to 3 Exams Scheduled on the Same Day or over a 24-hour period.</b>
October 10-18, 2020	Reading Week
November 18, 2020	Last day to <b>voluntarily withdraw</b> from 12-week session course. After this date students remain registered in the course and receive a final grade as appropriate. Last day for partial tuition refund.
December 11-22, 2020	Fall term <b>final examinations</b> .

## Learning Outcomes

In this course, students will be able to

1	Obtain an in-depth knowledge of computer arithmetic, understand number system, number representation, arithmetic operations, and design arithmetic circuits.
2	Identify design problems of arithmetic units, read research articles in this area and evaluate research studies as well as conducting independent research projects.
3	Explain the behavior of arithmetic systems, including adders and multipliers, describe their performance parameters, and examine adder and multiplier design methodologies.
4	Interpret the terminology related to number system and computer arithmetic and use software tools to simulate, optimize and validate the design parameters of arithmetic schemes.
5	Get involved in team works and independent studies through course assignments and projects.
6	Improve interpersonal skills and communications by presenting their projects and interacting with the instructor and other students.
7	The course includes a group based project requiring teamwork and collaboration skills.
8	Be creative to develop new idea in the area of number system and computer arithmetic, ability to critically apply knowledge of arithmetic scheme design to problems, write technical reports in a professional manner.
9	Realize the importance of number representation and arithmetic operations and establish the foundation for further study in this area.

This course will develop the following CEAB Graduate Attributes Criteria via Learning Outcomes:

CEAB Graduate Attributes Criteria	Course Learning Outcomes
1. A knowledge base for engineering	1,2,3,4,8

<b>Demonstrated competence in University level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.</b>	
<b>2. Problem analysis</b> <i>An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.</i>	1,2,3
<b>3. Investigation</b> <i>An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.</i>	1,2,3,6
<b>4. Design</b> <i>An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, economic, environmental, cultural and societal considerations.</i>	2,3,8
<b>5. Use of engineering tools</b> <i>An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.</i>	1,2,4
<b>6. Individual and team work</b> <i>An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.</i>	5,6,7
<b>7. Communication skills</b> <i>An ability to communicate complex engineering concepts within the profession and with society at large. Such abilities include reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.</i>	6,7,8
<b>8. Professionalism</b> <i>An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.</i>	9
<b>9. Impact of engineering on society and the environment</b> <i>An ability to analyse social and environmental aspects of engineering activities. Such abilities include an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society; the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.</i>	9
<b>10. Ethics and equity</b> <i>An ability to apply professional ethics, accountability, and equity.</i>	8,9
<b>11. Economics and project management</b> <i>An ability to appropriately incorporate economics and business practices including project, risk and change management into the practice of engineering, and to understand their limitations.</i>	5,7,9
<b>12. Life-long learning</b> <i>An ability to identify and to address their own educational needs in a changing world, sufficiently to maintain their competence and contribute to the advancement of knowledge.</i>	9

## Evaluation Methods

The course grade will be evaluated as follows:

Method of Evaluation	% of Final Grade	Due Dates*	Related Learning Outcomes
Assignments Approximately 4 (Individual)	10%	Click here to enter a date.	2,4,5,6,7,8,9
Midterm exam (Open-book)	20%	20/10/2020	1,2,5,6,7
Project (Group)	30%	Click here to enter a date.	1,2,3,4,5,6,7,8
Final exam (Open-book)	40%	TBA	1,2,5,6,7

\* According to [Bylaw 51, Section 1.1.2](#) and [1.1.3](#) respectively,

[http://athena.uwindsor.ca/units/senate/main.nsf/947f0bc672983a17852568b60051f690/bf28934998d7c7c3852578c3006e22d7/\\$FILE/Bylaw%2051%20-%20Examination%20Procedures%20\(Amended%20091209\).pdf](http://athena.uwindsor.ca/units/senate/main.nsf/947f0bc672983a17852568b60051f690/bf28934998d7c7c3852578c3006e22d7/$FILE/Bylaw%2051%20-%20Examination%20Procedures%20(Amended%20091209).pdf)

"Two to three hour examination slots will normally be scheduled in the formal final examination periods in each semester for all courses which terminate in that semester. All final testing procedures (written test, oral interview, essay, take home test, etc.) shall take place (or fall due, as the case may be) during the two to three-hour final examination slot so scheduled. The actual duration of testing procedures during the scheduled final examination slot may be less than the scheduled time, at the discretion of the individual instructor" ([Bylaw 51, Section 1.1.2](#)). "The last seven calendar days prior to, and including, the last day of classes in each period of instruction of twelve (or greater) weeks in duration must be free from any procedures for which a mark will be assigned, including the submission of assignments such as essays, term papers, and take home examinations. Courses that are presented by a specialized teaching method, where the testing procedures are an integral part of the instructional process, shall be exempt from this regulation subject to approval of the Dean of the Faculty in which the course is given" ([Bylaw 51, Section 1.1.3](#)).

## Grading

Grades for the course will be consistent with the following table, per the

[University of Windsor Policy P1: Standardization of Percentages Across the University](#)

[http://athena.uwindsor.ca/units/senate/main.nsf/947f0bc672983a17852568b60051f690/3c87fa97b5f64f7c852578ef006c00be/\\$FILE/Policy%20P1%20-%20Standardization%20of%20Percentages%20Across%20the%20University.pdf](http://athena.uwindsor.ca/units/senate/main.nsf/947f0bc672983a17852568b60051f690/3c87fa97b5f64f7c852578ef006c00be/$FILE/Policy%20P1%20-%20Standardization%20of%20Percentages%20Across%20the%20University.pdf)

☐ Graduate Course:

Numerical	90-100	85-89.9	80-84.9	77-79.9	73-76.9	70-72.9	67-69.9	63-66.9	60-62.9	35-59.9	00-34.9
Letter	A+	A	A-	B+	B	B-	C+	C	C-	F	F-

## Assessment Considerations

### Assignments:

There are about three to four assignments. Two to four assignments will be graded depending on class size and availability of the number of GAs. All assignments to be graded should be submitted through the course Blackboard website. **No email submission or hardcopy submission is allowed.** Late assignments will be deducted 10% per day up to 3 days (after which they will receive 0 marks). Assignment work should be completed independently. Penalty will be applied to your marks if evidence of plagiarism is found.

Solution to assignments will be posted on the course Blackboard website after three days past the submission deadline. Tutorial session/period to discuss solution to assignment/project problems may be provided later in class.

### Projects:

One course project is either individual or group based, depending on enrollment of the class. In case of group-based project, a list of group members should be formed and submitted online

within one week after the project information is posted at the course website. All project reports should be submitted through the course website. Project slides and oral presentation may also be required, depending on class enrollment. **No email submission or hardcopy submission is allowed.** Late project reports will be deducted 10% per day up to 3 days (after which they will receive 0 marks). Project work (if not group based) should be completed independently. Penalty will be applied to your marks if evidence of plagiarism is found.

## Midterm & Final Exams:

No electronic device except for a non-programmable calculator is allowed in the examinations. Missing midterm with proved legitimate reason will be handled that the weight of midterm will be moved to the final examination. Please do not miss the final examination. Please schedule business travel, et cetera to avoid conflict. **SORRY NO EXCEPTIONS.** There is no makeup final exam (except for the medical reasons with proof) and no extra-credit assignments.

### Calculators

Only non-programmable is allowed during tests/exams.

### Other Electronic Devices Aside from Calculators

- Electronic devices aside from calculators are **NOT** permitted during exams.
- Other electronic devices aside from calculators are permitted during Tests / exams / both?. Acceptable electronic devices include: Please state

### The Student Evaluation of Teaching (SET)

The SET will be administered in the course during the last two weeks of the semester.

### Exams and fire alarms

Pulling a fire alarm (e.g. during an exam) is a serious offence. The Criminal Code of Canada dictates that initiating a false alarm is a **criminal offence**. Such an offence could result in a criminal record, a large fine, as well as disciplinary action under the University of Windsor Bylaw 31 where serious consequences would be likely (see Appendices for student misconduct). In the event that a fire alarm disrupts an exam session, the decision on how to proceed or not proceed with the exam will be made by the instructor. Therefore, if students are evacuated from the building due to a fire alarm they should wait outside and receive instructions from the instructor.

### Supplemental Privileges

- A supplemental examination is **NOT** allowed in this course.
- A supplemental examination is allowed in this course.

The final grade for the supplemental evaluation WILL include the student's term work grade.



## General Class Expectations

### Attendance and punctuality

Attendance in classes is critical to student success; students should seize the opportunity to share and discuss information in tutorials, and classes. The course is designed to move swiftly and efficiently.

### Communication

Students are encouraged to utilize office hours to communicate with professor or GA for asking questions. No pre-emailing or phone call is required. Using non-office hours should be pre-arranged with at least two days in advance through email. If failed to show up at an email-arranged appointment, a cancellation email should be sent beforehand. Email anytime is welcomed. The professor will usually reply your email within 24 hours during work days if not immediately. Please use your UWind email account and add [8550] to your email subject, otherwise response could be delayed or even ignored. Email body should have proper addressing at the start and sender's name at the end.

### Group work

In case that a group-based project is required, student groups should be formed within seven days after the project information is posted at the course Blackboard website. It should be indicated who is going to submit the project report on behalf of the group.

### Academic Integrity

Per the [University of Windsor Bylaw 31: Student Affairs and Integrity](http://athena.uwindsor.ca/units/senate/main.nsf/947f0bc672983a17852568b60051f690/06e37bd761de3505852578c30069a8f8/$FILE/Bylaw%2031%20-%20Student%20Affairs%20Amended%2020080110%20-%20RW%20reviewed%20Sept%2028,%202011.pdf)

[http://athena.uwindsor.ca/units/senate/main.nsf/947f0bc672983a17852568b60051f690/06e37bd761de3505852578c30069a8f8/\\$FILE/Bylaw%2031%20-%20Student%20Affairs%20Amended%2020080110%20-%20RW%20reviewed%20Sept%2028,%202011.pdf](http://athena.uwindsor.ca/units/senate/main.nsf/947f0bc672983a17852568b60051f690/06e37bd761de3505852578c30069a8f8/$FILE/Bylaw%2031%20-%20Student%20Affairs%20Amended%2020080110%20-%20RW%20reviewed%20Sept%2028,%202011.pdf)

**Plagiarism:** the act of copying, reproducing or paraphrasing portions of someone else's published or unpublished material (from any source, including the internet), without proper acknowledgement. Plagiarism applies to all intellectual endeavours: creation and presentation of music, drawings, designs, dance, photography and other artistic and technical works. In the case of oral presentations, the use of material that is not one's own, without proper acknowledgment or attribution, constitutes plagiarism and, hence, academic dishonesty. (Students have the responsibility to learn and use the conventions of documentation as accepted in their area of study.)

For more information on academic integrity and student misconduct please see the appendices.

## CEAB Hours

Subject Areas	Accreditation Units
	One hour of lecture (corresponding to 50 minutes of activity) = 1AU One hour of laboratory or scheduled tutorial = 0.5 AU
Mathematics	9
Natural Sciences	-
Engineering Science	9



Engineering Design	18
Complementary Studies	-

Will there be a laboratory experience and safety procedures instruction? ☐ Yes ☒ No

### Services Available to Students at the University of Windsor

Students are encouraged to discuss any disabilities, including questions and concerns regarding disabilities, with the course instructor. Let's plan a comfortable and productive learning experience for everyone. The following services are also available to students:

- Sexual Misconduct Response & Prevention Office: <http://www.uwindsor.ca/sexual-assault>
- Student Accessibility Services: <http://www.uwindsor.ca/studentaccessibility/>
- Skills to Enhance Personal Success (S.T.E.P.S): <http://www.uwindsor.ca/lifeline/steps-skills-to-enhance-personal-success>
- Student Counseling Centre: <http://www.uwindsor.ca/scc>
- Academic Advising Centre: <http://www.uwindsor.ca/advising/>
- Writing Support Desk: <https://www.uwindsor.ca/success/318/writing-support-desk>
- Information Technology Services: <https://www.uwindsor.ca/itservices/support>
- Student Health Services: <https://www.uwindsor.ca/studenthealthservices/>
- Mental Health: <https://www.uwindsor.ca/wellness>

### Bylaws and Policies

The following are links to the University of Windsor bylaws and policies. The intention is to share these policies and bylaws with engineering students in a way that is straightforward and clear – because our learning depends on our ability to create an environment and culture that supports our individual and collective needs for learning and teaching.

University senate bylaws can be found: <http://www.uwindsor.ca/secretariat/49/senate-bylaws>

University senate policies can be found: <http://www.uwindsor.ca/secretariat/48/senate-policies>

### SoTL Research in Our Classroom

As your instructor, I approach teaching and learning in a scholarly way, which means that my teaching practices are supported by research and evidence derived from my classes. This course may also be evaluated as part of internal or external quality assurance processes and as part of ongoing curriculum design and improvement. As a student in this course, your Blackboard Learn student data may be used for evaluating the course delivery and your engagement in the various aspects of the course. If this occurs, it will only be after final grades are submitted and approved, so it will have no effect on your grade. The learning management course data provides information about your individual course usage and activity during the time that you are enrolled in the course. Your anonymized, aggregated data may also be used in the future in reports, articles or presentations.

Please note, that should I utilize information from a course for research, I will only do so with clearance from the University Research Ethics Board and which would satisfy the requirements of the *Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans*. Any such

research would involve having your free and informed consent first and would spell out the conditions for the research including how your privacy, security, and welfare would be protected.

### **Secondary Use**

As your instructor, I approach teaching and learning in a scholarly way, meaning that my teaching practices are informed by research and experience. This also means that I have an interest in research that occurs within a class or course and may utilize information from my courses as research data. Please note, that should I utilize information from a course, I will only do so with clearance from the University Research Ethics Board and which would satisfy the requirements of the *Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans*. Any such research would involve having your free and informed consent first and would spell out the conditions for the research including how your privacy, security, and welfare would be protected.

After the class is over and your final grades have been submitted and approved, I will be sending an e-mail to ask your consent to utilize the information from your course assignments and information from Blackboard as secondary data for research purposes. I will only do so with clearance from our University Research Ethics Board and within the guidelines of *Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans*.

### **Secondary use, evaluation, interviews and focus groups**

This course will be evaluated as part of internal or external quality assurance processes and reporting requirements to funding agencies and as research data for scholarly use. As a student in this course, your online student data will be used for evaluating the course delivery and your engagement in the various aspects of the course. This will only occur after final grades have been submitted and approved so it will have no effect on your grade. This course data provides information about your individual course usage and activity during the time that you are enrolled in the course, along with your performance on graded assignments. Your anonymized, aggregated data may also be used in the future in reports, articles or presentations.

During the final week of the course you will also be invited to participate in further research about the course. If you decide to participate you will be asked to fill out anonymous online questionnaires that solicit your impressions about the course design and student learning in the course. The survey participation is voluntary and no questions of a personal nature will be asked. Your participation will have no effect on your grade and your instructor will not know who participated in the surveys.

Finally, at the end of the survey you will also be asked if you want to participate in a focus group or interviews after final grades have been assigned to gather your assessment, combined with other students in the course, about specific course delivery methods and technologies used.