

Western University
Faculty of Engineering
Department of Electrical & Computer Engineering

ECE 9047L/9407L – Sensor Networks & Embedded Systems

COURSE OUTLINE 2023-2024

DESCRIPTION

This course covers various subjects related to Embedded Systems, Wireless Sensor Networks (WSNs), and Programmable Logic Controllers (PLCs). Embedded systems and PLCs are microprocessor-based systems, and they can be used together with WSNs for security monitoring, environmental information collection, tracking, and controlling. This course is designed to train students to acquire theory and practice hands-on skills in programming microcontrollers, and to understand and learn the fundamentals and architecture of WSNs and PLCs.

ENROLLMENT RESTRICTIONS

Enrollment in this course is restricted to graduate students registered in the M.Eng. or M.E.Sc. programs in the department of Electrical & Computer Engineering, and if capacity permits, to any student that has obtained special permission to enroll in this course from the course instructor as well as the Graduate Chair (or equivalent) from the student's home program.

COURSE FORMAT

This course will be delivered in person. Written notes disseminating the lecture content will be posted to the course website for review. Video lessons from previous years will be available as a learning aid, however material discussed in-person takes precedence. Class assignments will also be distributed and submitted using the course website.

TOPICS

Topic #	Description	Learning Activities	Tentative timeline
1	Lesson 1: Embedded Microcontroller Systems and Architecture	<ul style="list-style-type: none">• Video lessons• Written notes• Participation quizzes	Weeks 1-2
	Lesson 2: Assembly Language Programming	<ul style="list-style-type: none">• Video lessons• Written notes	Weeks 3-4

		<ul style="list-style-type: none"> • Participation quizzes • Lab 1 	
	Lesson 3: Controlling Peripherals	<ul style="list-style-type: none"> • Lectures • Written notes • Participation quizzes • Lab 2 	Weeks 5-6
2	Lesson 4: Wireless Sensor Networks	<ul style="list-style-type: none"> • Lectures • Written notes • Participation quizzes 	Week 7
	Lesson 5: Design Metrics for WSNs	<ul style="list-style-type: none"> • Lectures • Written notes • Participation quizzes • Lab 3 	Week 8
	Lesson 6: Applications and Implementation of WSNs	<ul style="list-style-type: none"> • Lectures • Written notes • Participation quizzes • Lab 4 	Week 9
3	Lesson 7: Programmable Logic Controllers	<ul style="list-style-type: none"> • Lectures • Written notes • Participation quizzes 	Week 10

SPECIFIC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	40%	<ul style="list-style-type: none"> • Quizzes • Labs • Examination 	<ul style="list-style-type: none"> • Understanding of advanced concepts and theories • Understanding of computational and/or empirical methodologies to solve related problems
Application of knowledge	40%	<ul style="list-style-type: none"> • Quizzes • Labs • Examinations 	<ul style="list-style-type: none"> • Ability to apply knowledge in a rational way to analyze a particular problem • Ability to use coherent approach to design a particular engineering system using existing design tools
Professional capacity / autonomy	10%	<ul style="list-style-type: none"> • Labs 	<ul style="list-style-type: none"> • Awareness of academic integrity • Ability to implement established procedures and practices in the coursework • Defends own ideas and conclusions • Integrates reflection into his/her learning process

Communication skills	10%	<ul style="list-style-type: none"> • Labs • Examination 	<ul style="list-style-type: none"> • Ability to communicate (oral and/or written) technical details of, and design strategies for, embedded systems and sensor networks. • Ability to communicate (oral and/or written) ideas and theory behind event-driven programming and random geometric graphs.
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ASSESSMENTS

Assessment Type	Material Covered	Weight
Participation Quizzes (eleven)	Topic 1, 2, & 3	10%
Labs (four)	Topic 1, Lessons 1-4	7.5%
	Topic 1, Lessons 5-7	7.5%
	Topic 2, Lessons 8-9	7.5%
	Topic 2, Lesson 10	7.5%
Final Exam (one)	Topics 1, 2, & 3	60%

Activities in which collaboration is permitted:

- Students can work together to complete participation quizzes and labs but must submit individual work. Some labs have individualized components.

Activities in which students must work alone (collaboration is not permitted):

- Final exam.

REQUIRED TEXTBOOK

None

OPTIONAL COURSE READINGS

- Jonathan W. Valvano, Embedded Systems: Introduction to Arm®Cortex-M Microcontrollers, 5th Ed., self-published by author (2014).
- Bhaskar Krishnamachari, Networking Wireless Sensors, Cambridge University Press, Cambridge UK (2005). DOI: 10.1017/CBO9780511541025.
- Frank Petruzella, Programmable Logic Controllers, 5thEd., McGraw-Hill Education, New York NY (2017).

CHEATING, PLAGIARISM/ACADEMIC OFFENCES

Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working

alone implies) and the activities in which they can collaborate or seek help; see information above and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offence. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence at the following website: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

CONDUCT

Students are expected to follow proper etiquette to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in course activities and/or is not following the rules and responsibilities associated with the course activities, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

HEALTH/WELLNESS SERVICES

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. Information regarding health- and wellness-related services available to students may be found at <http://www.health.uwo.ca/>.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Faculty of Engineering has a Student Wellness Counsellor. To schedule an appointment with the counsellor, contact Kristen Edwards (khunt29@uwo.ca) via confidential email and you will be contacted by our intake office within 48 hours to schedule an appointment.

Students who are in emotional/mental distress should refer to Mental Health@Western: <http://www.uwo.ca/uwocom/mentalhealth/> for a complete list of options about how to obtain help.

SICKNESS

Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.

Students who are not able to meet certain academic responsibilities due to medical, compassionate or other legitimate reason(s), could request for academic consideration. The Graduate Academic Accommodation Policy and Procedure details are available at:

<https://www.eng.uwo.ca/graduate/current-students/academic-support-and-accommodations/index.html>

ACCESSIBLE EDUCATION WESTERN (AEW)

Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program. Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW): http://academicsupport.uwo.ca/accessible_education/index.html

AEW is a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.