Western University - Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 4412b – Intelligent Transportation Systems - Course Outline 2024

This course is intended to introduce students to different technologies used in Smart Mobility. Special emphasis is given to how these relate to traffic operations, active mobility and road safety.

- We will explore issues related to impact of technologies on mobility and transportation infrastructure.
- The course is self-contained with preliminary concepts explained in advance during the lectures.
- Students will learn basic Python Programming skills as they will interact, collaborate and work on topics relevant to the smart mobility and infrastructure. They will be exposed to the latest relevant research through papers readings, projects and presentations.
- Guest lecturers will be invited to present expert related materials, to bring practical experience to the classroom, and to promote interactive discussions on the subject.

Calendar Copy:
Introduction to the ITS framework designed for planning, defining, and integrating intelligent transportation systems. ITS is the application of information and communications technologies to transportation to enhance safety, efficiency, reliability, and mobility. ITS applications, including but not limited to, Travel Demand Management (TDM), Traveler Information, Transit Management, and Connected and Automated Vehicles (CAVs).

Prerequisites:
CEE 4401 Introduction to Transportation

Antirequisites:
None

Note: It is the student's responsibility to ensure that all Prerequisite and Corequisite conditions are met or that special permission to waive these requirements has been granted by the Faculty. It is also the student's responsibility to ensure that they have not taken a course listed as an Antirequisite. The student may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Corequisite or Antirequisite conditions.

Contact Hours:
3 lecture hours/week (required);

Relevant Key Sessional Dates:
Classes begin: January 8, 2024
Reading Week: February 17 – 25, 2024
Classes end: April 8, 2024

Contingency plan for an in-person class pivoting to 100% online learning
In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, affected course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will **not** change. Any remaining assessments will also be

conducted online as determined by the course instructor.

Instructor:

Course instructor: Dr. Mohamed Zaki
Email address: mzaki9@uwo.ca
Office: Spencer Engineering Building (SEB 3083)
Lecture hours: 3 hours lecture per week
Office hours: Monday 2:30pm - 3:30pm or by appointment
Administrative Support: SEB 3005 or civil@uwo.ca

Textbook:
No specific textbook will be needed. Course notes and handouts are the primary references used in this course. Resources will be posted on the course webpage.

Other References:
- Handbook of Intelligent Vehicles. Editor: A. Eskandarian. ISBN 978-0-85729-084-7, pp. 1599, Springer, 2012 (PDF copy available via the online library)
- Smart Mobility – Connecting Everyone Trends, Concepts, and Best Practices. Barbara Flügge Editor, ISBN ISBN 978-3-658-15622-0, 2017 (PDF Copy available via the online library)
- University Course on Bicycle and Pedestrian Transportation, February 2006 - FHWA-HRT-06-065 (available online)

Additionally, lecture notes, Journal papers and other reading material will be distributed to the students.

This course **requires internet access and access to specific open access software**. Installation instructions for the software packages used in the project will be provided as part of the course materials and via OWL.

Notes: Software Coding sessions will be provided. For best learning experience during those sessions, it is highly recommended to have a laptop/Tablet with internet access. Also, during some of those lectures, the instructor will provide in class engagement assignments with bonus points.

Students are responsible for checking the course OWL site (http://owl.uwo.ca) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class.

All course material will be posted to OWL: http://owl.uwo.ca.

If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Units:
Both SI and FPS unit systems may be used in lectures, tutorials and examinations.

Specific Learning Objectives:

The lectures and assignments will prepare students to do the following [GA Indicator]:

- Understand the needs and basic technology concepts underlying intelligent transportation systems [KB3]
- Build a knowledge base of innovation and technology applications in smart mobility, road safety and active mobility [KB3, PA2]
- Develop principled problem-solving strategies and techniques related to traffic operations and road safety [PA2, ET1]
- Develop coding skills in Python Programming Language to implement, simulate and analyze intelligent transportation system applications [ITW2, ET2, I3]

TOPICS

Topic #	Description	Learning Activities	Tentative timeline
1	Introduction		
	Lesson 1: Present Course Syllabus, course expectations, revise basics of traffic flow theory and introduce micro-simulation models	Lecture 1: 3-hours class reading material (TBD)	Week 1
2	Programming with Python		
	Lesson 2: Introduce Programming learning principles of Python including variables, operations, statements, sequences	Lecture 2: 3-hours class reading material (TBD) In-class exercises	Week 2
	Lesson 3: learn principles of Python (cont') Logic, control flow, loops, dictionaries, Functions, computational packages	Lecture 3: 3-hours class reading material (TBD) Assignment 1 (Due) In-class exercises	Week 3
3	Intelligent Transportation Systems		
	Lesson 4: Learn about traffic management and operation; Advanced Traveler information, Smart Work Zones. Other items covered: Project Description, Traffic Simulator tutorial	Lecture 4: 3-hours class In-class exercises reading material (TBD) Assignment 2 (Due)	Week 4
	Lesson 5: Learn about adaptive Traffic signals, pro-active road safety management and traffic conflicts techniques	Lecture 5: 3-hours class Additional reading material Assignment 3 (Due)	Week 5
4	Data Collection for Active transportation		
	Lesson 6: Learn about data collection techniques, behavior analysis, counts of pedestrian and cyclists. Case studies will be discussed	Lecture 6: 3-hours class reading material (TBD)	Week 6
5	Research Paper Presentations		
	Lesson 7: Student will present and discuss research papers	Students presentations Lecture 7: 3-hours class	Week 7
6	Connected Transportation and Vehicular Networks		

	Lesson 8: Introduction to networking and connected vehicles. Learn Connectivity requirements for road safety	Lecture 8: 3-hours class reading material (TBD) Project Update Report (Due)	Week 8
	Lesson 9: Learn Protocols Design and information sharing, platooning and V2X communication. Learn how to implement those concepts for traffic simulation	Lecture 9: 3-hours class reading material (TBD) Quiz	Week 9
Topic #	Description	Learning Activities	Tentative timeline
7	Future Mobility		
	Lesson 10: Learn about the future of transportation. Lecture will include guest presentations	Lectures 10: 3-hours class reading material (TBD) Assignment 4 (Due)	Week 10
	Lesson 11: Learn concepts of autonomous vehicles. Case studies in safety will be discussed. Group Project presentations	Lectures 11: 3-hours class reading material (TBD) Assignment 5 (Due)	Week 11
8	Review		
	Lesson 12: Review main concepts, with problem solving. Group Project presentations	Lectures 12: 3-hours class reading material (TBD)	Week 12

Note:
The instructor may expand or revise material presented in the course as appropriate.
Dates and deadlines for presentations and submissions will be confirmed during the class
Invited speaker's information will be announced as soon as finalized

General Learning Objectives:

E=Evaluate, T=Teach, I=Introduce; (I) = Introduction, (D) = Developing, (A) = Advanced level

Knowledge Base	E	Engineering Tools	I	Impact on Society	
Problem Analysis	T	Team Work	E	Ethics and Equity	
Investigation	E	Communication	T	Economics and Project Management	
Design		Professionalism		Life-Long Learning	

Evaluation:

The final mark will be determined as follows:

Participation	5 %
Assignments	20 %
Quizzes	10 %
Written Final Examination	20 %
Paper Review and Presentation	5%
Course Project	40 %
Total	100 %

1. **Quizzes and Examinations:**

A one-hour quiz will be held during the week 9. Exact date will be announced at least 4 weeks in advance. The quiz is open book.

A three-hour written final examination (open book) will be held during the regular examination period.

2. **Assignments:**

Homework Assignments (Five in Total -Best of Four with 5% each). The assignments will be posted on course OWL with the due date and time indicated. Late homework will not be accepted. Each assignment must be submitted as a single PDF file through OWL. In case of programming assignments, the code files will also be uploaded. A tutorial on how to submit an assignment in Python will be provided. Except when explicitly specified, all assignments are to be completed individually. Students must write and program their own work. Copying homework from another student/group, or other sources is a violation of academic integrity (see below).

Research Paper Review and Presentation

Short paper critique covering some of main modules of the course will be required. The instructor will distribute papers directly for students for review and critique. The instructions and rubric will be posted on OWL. Due dates for this homework will be clearly announced in the first week of class. No late homework will be accepted. All assignments should be done neatly and professionally.

Final project and presentation

Students can choose to work individually or in a group of 3 on a project relevant to the material taught in the class. Related software tools and data sets will be provided. A project grade will be divided between a proposal report, progress report, individual contribution and a final paper and presentation. Each group will work closely with the instructor in defining the project scope. Students are encouraged to come up with their idea for the project. A presentation summarizing the efforts and the results will be scheduled before the final project report submission. Instructions, formatting and rubric will posted online through OWL. The breakdown of grades for the Final Project is as follows:

Item	**Breakdown**
Project proposal	5%
Project update report	5%
Teamwork and interaction (Team Journal Logs and minutes)	5%

End of Semester Presentation	10%
End of Semester Report	15%
Total	40%

Activities in which collaboration is permitted:

Participation using course OWL site Forums : Regular forums will be posted on the course site OWL. Students are expected to interact with the course content and with each other by posting questions/responding to existing questions on OWL Forums . Group discussion using Forums regarding course material and topics covered in lectures is permitted.
Final Project: Students will be divided into groups. Collaboration between only group members is permitted.

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

- Assignments
- Quiz
- Paper review and presentation
- Final exam

3. 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.

4. Additional Information to Consider

Cheating:

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

For more information on scholastic offenses, please see:
http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf

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 concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Accommodation and Accessible Education:

Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation_disabilities.pdf

Conduct:

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others. Please turn off your cell phone before coming to a class, tutorial, quiz or exam. On the premises of the University or at a University-sponsored program, students must abide by the Student Code of Conduct:

https://www.uwo.ca/univsec/pdf/board/code.pdf

Sickness and Other Problems

Academic Consideration for ALL Absences

Students should immediately consult with the instructor if they have any problems that could affect their performance in the course. The student should seek advice from the instructor regarding how best to deal with the problem. Failure to notify the instructor (or as soon as possible thereafter) will have a negative effect on any appeal. Please visit the link below for information on how to submit a request for Academic Consideration:

https://www.eng.uwo.ca/undergraduate/academic-consideration-for-absences.html

Academic Policies:

The website for Registrarial Services is http://www.registrar.uwo.ca

In accordance with policy,

https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf

The centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.

Scholastic offences are taken seriously, and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

Support Services:

Please visit the Western Engineering Undergraduate Services webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.eng.uwo.ca/undergraduate/index.html

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

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 sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

https://www.uwo.ca/health/student_support/survivor_support/get-help.html

To contact a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (https://learning.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: https://www.uwo.ca/se/digital/

Additional student-run support services are offered by the USC, https://westernusc.ca/services/

Course Breakdown: (Values given in accreditation units)
Engineering Science = 100%