Western University
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9412b – Intelligent Transportation Systems

Course Outline – Winter 2024

DESCRIPTION

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.

ENROLLMENT RESTRICTIONS

Enrollment in this course is restricted to graduate students with bachelor's degree in Civil Engineering, as well as any student that has obtained permission to enroll in this course from the course instructor as well as the Graduate Chair (or equivalent) from the student's home program.

PREREQUISITE

CEE 4401 Introduction to Transportation or similar

INSTRUCTOR CONTACT INFORMATION

- Course instructor: Dr. Mohamed Zaki
- Email address: mzaki9@uwo.ca
- Lecture hours: 3 hours lecture per week
- Office hours: Weekly office hours will be held either in person or via Zoom
- *Administrative Support*: PhD and MESc students: ceeresearchgrad@uwo.ca
  MEng students: ceeprofessionalgrad@uwo.ca

COURSE FORMAT

This course will be delivered **in-person**.

"In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining 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 at the discretion of the course instructor"

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-hour 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-hour 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-hour 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-hour 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-hour 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-hour class Reading material (**TBD**)	Week 6
5	**Research Paper Presentations**		
	Lesson 7: Students will present and discuss research papers	Students presentations Lecture 7: 3-hour 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-hour 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-hour class reading material (**TBD**) Quiz	Week 9
7	**Future Mobility**		
	Lesson 10: Learn about the future of transportation. Lecture will include guest presentations	Lectures 10: 3-hour 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-hour 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-hour class Reading material (**TBD**)	Week 12

Attention:

- Dates and deadlines for presentations and submissions will be confirmed during the class
- There will be no class during the winter reading week
- Invited speaker's information will be announced as soon as finalized

SPECIFIC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	30%	- Assignments - Quiz - Final exam - Project	- Understanding of advanced concepts and theories - Awareness of important current problems in the field of study - Understanding of computational and/or empirical methodologies to solve related problems
Research &scholarship	15%	- Paper Review - Project	- Ability to conduct critical evaluation of current advancements in the field of specialization - Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment
Application of knowledge	20%	- Assignments - Final exam - Project - Quiz	- 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%	- Project	- 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	15%	- Paper review - Project	- Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively

Awareness of limits of knowledge	10%	- Project	- Awareness of the need of assumptions in complex scientific analyses and their consequences - Understanding of the difference between theoretical and empirical approaches - Ability to acknowledge analytical limitation due to complexity of practical problems

COURSE MATERIAL

Prepared class notes will be made available through the course website on OWL at http://owl.uwo.ca/, along with other useful reference material and data for assignments.

Lecture notes and any posted demonstration videos are copyrighted to the instructor and legally protected. Do not post these videos and lecture notes on any other website or online forums. The recording of the live/synchronous lectures of the course without the permission from the course instructor is prohibited. The illegal posting and sharing of the copyrighted course content could be subjected to legal actions.

REFERENCES

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 are listed below:

- 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.

COMPUTING

This course requires internet access and access to specific open source 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.

Terms of use: Free student downloads are for educational use only and may only be used for self-learning, student instruction, student projects, and student demonstrations.

ASSESSMENT

Assessment Type	Material Covered	Tentative Due Date*	Weight
Homework Assignments (Five in Total -Best of Four with 5% each)	Topics 1, 2, 3, 4, 5, 6, 7	Check course calendar	20%
Participation and Engagement	In person and posted questions in course OWL site "Forums"	Weekly activity	5%
Final Project		Dec. 5th, 2022	40%
Final Exam (Open Book)	Topics 1 - 8	Examination Period	20%
Research Paper Review and Presentation	Topic 1-8	Week 7	5%
Quiz (Open Book)	Topic 1, 2,3, 4,6	Week 9	10%

* The shown dates are an approximate guide for students and are subject to change.

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.

Assignments

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).

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%

Quiz and Final Exam

The quiz and the final exam will be open book and will comprise a combination of design questions, data-set, and short-answer questions. In the case the quiz is rescheduled, there will be an announcement at least eight days in advance of the new date. In the case of unexpected events that delay a quiz (e.g., COVID Lockdown, wide-spread power outage), the next available date will be selected.

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

Activities in which collaboration is permitted:

- *Participation using course OWL site "Forums"*: Weekly forums will be posted on the course site OWL. Each week students are expected to interact with the course content and with each other by posting questions/responding to existing questions on OWL "Forums". Minimum expectation regarding this participation activity is at least one posting per week. Group discussion using "Forums" regarding course material and topics covered in lectures is permitted.
- *Final Project*: Students will be divided into groups (2 members per group). Collaboration between ***only*** group members is permitted. One final project report is required from each group.

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

- Homework Assignments
- Quiz
- Final Exam
- Research Paper Review and Presentation

UNITS

SI units will be used in lectures and examinations

USE OF ENGLISH

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks onall assignments, tests, and examinations for the improper use of English. Additionally, poorly writtenwork with the exception of the final examination may be returned without grading. If resubmissionof the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

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 offense. 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. Information on how to schedule an appointment with the counsellor is available at: https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/Student-Wellness-Counselling.html

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.