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

CEE 4402b –Smart Mobility: Transportation Technologies and Applications - Course Outline Winter 2025

This course is intended to introduce students to different technologies used in Intelligent Transportation Systems and artificial Intelligence applications in transportation. Special emphasis is given to how these relate to traffic operations, autonomous driving and road safety.

- We will explore issues related to impact of machine learning technologies on road mobility and transportation infrastructure.
- The course is self-contained with preliminary concepts explained in advance during the lectures.
- Students will learn basic reinforcement learning and computer vision 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. Artificial Intelligence applications in ITS including but not limited to traffic safety diagnosis, adaptive traffic operation, autonomous driving, traffic prediction and road-users travel behaviour.

Prerequisites:
CEE 4401 Introduction to Transportation

Antirequisites:
None

Corequisites:
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, 2025
Reading Week: February 17 – 25, 2025
Classes end: April 2, 2025

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: Wednesday 10:30pm - 12:30pm 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)
• Reinforcement Learning An introduction (Second Edition) by Richard S. Sutton and Andrew G. Barto (MIT Press, Cambridge, MA, 2018, available online), ISBN: 0262039249

 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 Brightspace site (https://westernu.brightspace.com/d2l/login) 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 Brightspace: https://westernu.brightspace.com/d2l/login

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 Intelligent Transportation Architecture and Service Packages	Lecture 1: 3-hours class reading material (TBD)	Week 1
2	**Machine Learning for Traffic Operation**		
	Lesson 2: Introduce principles of Reinforcement learning (RL) and markov decision process Learning basics of RL environment training	Lecture 2: 3-hours class reading material (TBD) In-class exercises	Week 2
	Lesson 3: learn concepts of traffic microsimulation, simulation calibration, designing simple road network Build RL environment for microsimulation and train using Q Learning	Lecture 3: 3-hours class reading material (TBD) Assignment 1 (Due) In-class exercises	Week 3
3	**Machine Learning for Proactive Traffic Safety**		
	Lesson 4: Learn about traffic safety, and traffic conflicts techniques. Learn algorithm for evaluating traffic safety from video data	Lecture 4: 3-hours class In-class exercises reading material (TBD) Assignment 2 (Due)	Week 4
	Lesson 5: Learn about video processing, camera calibration, image segmentation and features tracking Learn to generate road-users trajectories from video frames.	Lecture 5: 3-hours class Additional reading material Assignment 3 (Due)	Week 5
4	**Autonomous Vehicles Perception**		
	Lesson 6: Learn about data sensors, data fusion, control and Levels of Autonomous driving, vehicle	Lecture 6: 3-hours class reading material (TBD)	Week 6

	perception approaches. Machine learning based Case studies will be discussed	Assignment 4 (Due)	
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 Communication Networks**		
	Lesson 8: Introduction to networking and connected vehicles. Learn Connectivity requirements for traffic 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 microsimulation	Lecture 9: 3-hours class reading material (TBD) Quiz	Week 9
7	**Selected Topics in Future Mobility**		
	Lesson 10: Learn about the future of urban land and air mobility transportation. Lecture will include guest presentations	Lectures 10: 3-hours class reading material (TBD) Assignment 5 (Due)	Week 10
	Lesson 11: Learn concepts of traffic sensors for curbside management and smart workzones. Case studies will be discussed Group Project presentations	Lectures 11: 3-hours class reading material (TBD)	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
This course may have a field trip. Trip is accessible through public transit. No additional cost.

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 %

Notes**:** (a) **Students must pass the final examination to pass this course**. Students who fail the final examination will be assigned the aggregate mark, as determined above, or 48%, whichever is less.

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

I. **Missed/Late Accommodation Policy:**
1. Students missing a test/assignment/lab or examination you will report the absence by submitting Academic Consideration Request form through STUDENT ABSENCE PORTAL.
2. Documentation must be provided as soon as possible.

II. **Exam Accommodation:**
1. If you are unable to write a final examination, report your absence using the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
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 the Academic Consideration Request Form through STUDENT ABSENCE

[PORTAL](#).
PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

III. **Late Assignments:**
   1. Students must advise the course instructor if they are having difficulty completing an assignment on time (prior to the due date of the assignment).
   2. Students should be prepared to submit the Academic Consideration Request Form and provide documentation if requested to do so by the course instructor (see reverse side for information on documentation).
   3. If granted an extension, a revised due date should be established with the course instructor. 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. This course has 10 assignments with only 8/10 assignments counted towards your final grade. Academic consideration will not be granted for missed assignments. If students miss 2/10 assignments, the remaining 8 assignments will be used in the calculation of the final grade. If students miss more than 2 assignments, they will receive a grade of zero on each missed assignment.
   5. This course employs flexible deadlines for assignments. The assignment deadlines can be found above in the course outline. For each assignment, students are expected to submit the assignment by the deadline listed. Should illness or extenuating circumstances arise, students are permitted to submit their assignment up to 72 hours past the deadline without academic penalty. Should students submit their assessment beyond 72 hours past the deadline, a late penalty of XX% per day will be subtracted from the assessed grade. As flexible deadlines are used in this course, requests for academic consideration will not be granted. If you have a long-term academic consideration or an accommodation for disability that allows greater flexibility than provided here, please reach out to your instructor at least one week prior to the posted deadline.
   6. 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.

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

IV. **Medical Accommodation:**
   1. Requests for Academic Consideration Request Form through [STUDENT ABSENCE PORTAL](#).
   2. Requests for academic consideration must include the following components:
      a. Self-attestation signed by the student (*This is only accepted for the first/one absence*)
      b. Medical note
      c. Indication of the course(s) and assessment(s) affected by the request
      d. Supporting documentation as relevant
   3. Requests without supporting documentation are limited to one per term per course.

4. **Students must request academic consideration as soon as possible and no later than 48 hours after the missed assessment.**
5. Once the request and supporting documents have been received and reviewed, appropriate academic consideration, if granted, shall be determined by the instructor in consultation with the academic advisor, in a manner consistent with the course outline. Academic consideration may include extension of deadlines, waiver of attendance requirements for classes/labs/tutorials, or re-weighting of course requirements. Some forms of academic consideration, such as arranging Special Examinations, assigning a grade of Incomplete, or granting late withdrawals without academic penalty, may only be granted by the Academic Advising office of the Faculty of Engineering.

V. Religious Accommodation:

When scheduling unavoidably conflicts with religious holidays, which (a) require an absence from the University or (b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate Department Chair and, if necessary, the student's Dean.

It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action.

VI. Academic Integrity:

In the Faculty of Engineering, we encourage students to create a culture of honesty, trust, fairness, respect, responsibility, and courage, befitting the professional degree you are pursuing.

Please visit Academic Integrity Western Engineering for more information

VII. Academic Offences:

Plagiarism means using another's work without giving credit. The university has rules against plagiarism and other scholastic offences. Western Engineering has a zero-tolerance policy on plagiarism. The minimum penalty is zero on the course work and a repeat offence will earn you zero on the course. A third offence may lead to expulsion from the university.
Scholastic Discipline for Undergraduate Students & Cheating, Plagiarism and Unauthorized Collaboration: What Students Need to Know

Students must write their reports, 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.

All required papers may be subject to submission for textual similarity review to commercial plagiarism detection software under license to the University for the detection of plagiarism. All

papers submitted will be included as source documents on 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). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

VIII.   Faculty of Engineering AI Policy:
The use of generative Artificial intelligence (GenAI) tools won't be discouraged in the Faculty of Engineering. As we pride ourselves on building the future we can't hide from the use of GenAI tools to contribute to the understanding of the course materials. However, the use of GenAI tools in any assignment or contribution during the course will have to be disclosed, as a resource. GenAI tools use won't be permitted in any type of examination or other assessments where the faculty have prohibited their use. If use of GenAI tools is detected by the instructor in these instances, academic offences penalties might be imposed against the student.

IX.   Use of English Policy:
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 except for 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.

X.   Accessibility:
Western is committed to achieving barrier free accessibility for persons with disabilities studying, visiting and working at Western. As part of this commitment, there are a variety of services, groups and committees on campus devoted to promoting accessibility and to ensuring that individuals have equitable access to services and facilities. To help provide the best experience to all members of the campus community, please visit the Accessibility Western University for information on accessibility-related resources available at Western.

Students with disabilities may arrange for academic accommodation at Western. For a more detailed explanation, please visit Academic Support & Engagement -Academic Accommodation.

XI.   Inclusivity, Diversity, and Respect:
The Faculty of Engineering at Western University is committed to creating equitable and inclusive learning environments that value diverse perspectives and experiences. We recognize that university courses often marginalize students based on social identity characteristics such as, but not limited to, Indigeneity, race, ethnicity, nationality, ability, gender identity, gender expression, sexuality, age, language, religion, and socioeconomic status. Understanding this, we strive to facilitate equitable experiences and inclusion within the classroom by respecting and integrating multiple ways of knowing, being, and doing. Please visit the Office of Equity, Diversity and Inclusion.

XII.   Health and Well-Being:

- [Health & Wellness Services – Students](#) - Offers appointment-based medical clinic for all registered part-time and full-time students.
- [Mental Health Support](#) - Provides professional and confidential services, free of charge, to students needing assistance to meet their personal, social and academic goals. Services include consultation, referral, groups and workshops, as well as brief, change-oriented psychotherapy.
- [Crisis Support](#) - For immediate assistant, please visit Thames Hall Room 2170 or call 519-661-3030. The crisis clinic operates between 11:00 am - 4:30 pm. For after-hours crisis support, click [here](#).
- [Gender-Based Violence and Survivor Support](#) - 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.](#)

Important Contacts:

[Engineering Undergraduate Services](#)	SEB 2097	519-661-2130	engugrad@uwo.ca
[Civil & Environmental Engineering](#)	SEB 3005	519-661-2139	civil@uwo.ca
[Office of the Registrar/Student Central](#)	WSSB 1120	519-661-2100	

Important Links:
- [WESTERN ACADEMIC CALENDAR](#)
- [ACADEMIC RIGHTS AND RESPONSIBILITIES](#)