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
- Office: Spencer Engineering Building (SEB 3083)
- Lecture hours: 3 hours lecture per week – Monday 9:30 am – 10:30 am and Thursday 2:30pm-4:30pm (Room: TBD)
- Office hours: Weekly office hours will be held either in person or via Zoom
- Administrative Support: PhD and MSc students: ceeeresearchgrad@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

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

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<tr>
<th>7</th>
<th><strong>Future Mobility</strong></th>
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</table>
| **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 |

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<thead>
<tr>
<th>8</th>
<th><strong>Review</strong></th>
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| **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
<table>
<thead>
<tr>
<th>Degree Level Expectation</th>
<th>Weight</th>
<th>Assessment Tools</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth and breadth of knowledge</td>
<td>30%</td>
<td>- Assignments</td>
<td>- Understanding of advanced concepts and theories</td>
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<tr>
<td></td>
<td></td>
<td>- Quiz</td>
<td>- Awareness of important current problems in the field of study</td>
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<td></td>
<td></td>
<td>- Final exam</td>
<td>- Understanding of computational and/or empirical methodologies to solve related problems</td>
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<td></td>
<td>- Project</td>
<td></td>
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<tr>
<td>Research &amp; scholarship</td>
<td>15%</td>
<td>- Paper Review</td>
<td>- Ability to conduct critical evaluation of current advancements in the field of specialization</td>
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<tr>
<td></td>
<td></td>
<td>- Project</td>
<td>- Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment</td>
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<tr>
<td>Application of knowledge</td>
<td>20%</td>
<td>- Assignments</td>
<td>- Ability to apply knowledge in a rational way to analyze a particular problem</td>
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<tr>
<td></td>
<td></td>
<td>- Final exam</td>
<td>- Ability to use coherent approach to design a particular engineering system using existing design tools</td>
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<tr>
<td></td>
<td></td>
<td>- Project</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>- Quiz</td>
<td></td>
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<tr>
<td>Professional capacity / autonomy</td>
<td>10%</td>
<td>- Project</td>
<td>- Awareness of academic integrity</td>
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<td>- Ability to implement established procedures and practices in the coursework</td>
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<tr>
<td></td>
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<td></td>
<td>- Defends own ideas and conclusions</td>
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<td>- Integrates reflection into his/her learning process</td>
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<tr>
<td>Communication skills</td>
<td>15%</td>
<td>- Paper review</td>
<td>- Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively</td>
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<tr>
<td></td>
<td></td>
<td>- Project</td>
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<tr>
<td>Awareness of limits of knowledge</td>
<td>10%</td>
<td>- Project</td>
<td>- 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</td>
</tr>
</tbody>
</table>

**COURSE MATERIAL**

Prepared class notes will be made available through the course website on OWL at [http://owl.uwo.ca/](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:

- 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

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

* 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:

<table>
<thead>
<tr>
<th>Item</th>
<th>Breakdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project proposal</td>
<td>5%</td>
</tr>
<tr>
<td>Project update report</td>
<td>5%</td>
</tr>
</tbody>
</table>
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 on all assignments, tests, and examinations for the 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.

**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. 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.