

## CEE 9413 – Urban Transportation Network and Emerging Technologies

### COURSE OUTLINE 2024-2025

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#### DESCRIPTION

Urban transportation is the backbone of the cities and communities. Development of transportation networks and emerging technologies are growing rapidly for sustainable and efficient travels and mobility. This course will introduce students the concepts and methods in the domain including basic concepts in transportation networks and minimization problems; equilibrium analysis of transportation networks; formulations of assignment problems; review of optimization algorithms; solving for user equilibrium; variable travel demand; trip distribution and traffic assignment models.

#### ENROLLMENT RESTRICTIONS

Enrollment in this course is restricted to graduate students in Civil and Environmental & Electrical and Computer Engineering, as well as any graduate 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.

#### INSTRUCTOR CONTACT INFORMATION

Course instructor: Yili (Kelly) Tang

Email address: [ytang564@uwo.ca](mailto:ytang564@uwo.ca)

Office: TBA

Office hours: TBA

#### 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

Topics	Learning Activities	Tentative timeline
Lesson 1: Overview of Urban Transportation Networks	<ul style="list-style-type: none"><li>• Lectures</li><li>• Additional reading material</li></ul>	Week 1

Lesson 2: Basic Concepts in Minimization Problems	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Additional reading material</li> </ul>	Week 2
Lesson 3: Formulation of the traffic assignment problem as a mathematical problem (I)	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Additional reading material</li> <li>• Assignment #1</li> </ul>	Week 3
Lesson 4: Formulation of the traffic assignment problem as a mathematical problem (II)	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Additional reading material</li> </ul>	Week 4
Lesson 5: Review of some optimization algorithms	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Additional reading material</li> </ul>	Week 5
Lesson 6: Solving for user equilibrium	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Additional reading material</li> <li>• Assignment #2</li> <li>• Course project</li> </ul>	Week 6
Lesson 7: User equilibrium with variable demand	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Additional reading material</li> </ul>	Week 7
Lesson 8: Trip distribution and traffic assignment model	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Additional reading material</li> </ul>	Week 8
Lesson 9: Review of discrete choice Models	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Additional reading material</li> <li>• Assignment #3</li> </ul>	Week 9
Lesson 10: Stochastic user equilibrium	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Additional reading material</li> </ul>	Week 10
Lesson 11: Network analysis with emerging technologies (I)	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Additional reading material</li> </ul>	Week 11
Lesson 12: Network analysis with emerging technologies (II)	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Project Presentations</li> </ul>	Week 12

\*\*\* There will be no class during Reading Week

### SPECIFIC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
<b>Depth and breadth of knowledge</b>	30%	<ul style="list-style-type: none"> <li>• Assignments</li> <li>• Project</li> <li>• Examinations</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding of advanced concepts and theories</li> <li>• Awareness of important current problems in the field of study</li> <li>• Understanding of computational and/or empirical methodologies to solve related problems</li> </ul>
<b>Research &amp; scholarship</b>	15%	<ul style="list-style-type: none"> <li>• Project</li> </ul>	<ul style="list-style-type: none"> <li>• Ability to conduct critical evaluation of current advancements in the field of specialization</li> <li>• Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment</li> </ul>

<b>Application of knowledge</b>	25%	<ul style="list-style-type: none"> <li>• Assignments</li> <li>• Project</li> <li>• Examinations</li> </ul>	<ul style="list-style-type: none"> <li>• Ability to apply knowledge in a rational way to analyze a particular problem</li> <li>• Ability to use coherent approach to design a particular engineering system using existing design tools</li> </ul>
<b>Professional capacity / autonomy</b>	5%	<ul style="list-style-type: none"> <li>• Project</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness of academic integrity</li> <li>• Ability to implement established procedures and practices in the coursework</li> <li>• Defends own ideas and conclusions</li> <li>• Integrates reflection into his/her learning process</li> </ul>
<b>Communication skills</b>	15%	<ul style="list-style-type: none"> <li>• Project</li> </ul>	<ul style="list-style-type: none"> <li>• Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively</li> </ul>
<b>Awareness of limits of knowledge</b>	10%	<ul style="list-style-type: none"> <li>• Project</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness of the need of assumptions in complex scientific analyses and their consequences</li> <li>• Understanding of the difference between theoretical and empirical approaches</li> <li>• Ability to acknowledge analytical limitation due to complexity of practical problems</li> </ul>

## ASSESSMENTS

Assessment Type	Material Covered	Tentative Due Date	Weight
Homework Assignments (three)	Topics 1 - 9	TBA	30%
Project report (one)	Project topic to be decided later	TBA	30%
Final Examination	Open book	Last Lecture	40%

### Activities in which collaboration is permitted:

- Project report can involve collaborations with group work.

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

- Assignments and final examination

## 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.

## **REQUIRED TEXTBOOK**

1. Urban Transportation Networks: Equilibrium Analysis with Mathematical Programming Methods, By Sheffi, Y. (1985), Published by Prentice-Hall, Inc. NJ., (<http://web.mit.edu/sheffi/www/urbanTransportation.html>) (freely downloadable, the author granted permission to any person to copy this book for use in education and research)

## **OPTIONAL COURSE READINGS**

2. Discrete Choice Analysis: Theory and Application to Travel Demand, By Ben-Akiva and Steven R. Lerman, Published by MIT in 1985
3. US Department of Transportation manuals and other relevant materials for traffic assignments.

## **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.

## **STATEMENT ON THE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE (AI)**

The use of generative artificial intelligence (AI) tools won't be discouraged. However, the use of generative AI tools is limited to improve and revise contribution during the course, not for original draft and resources. In the meantime, the use of generative AI tools in any assignment or contribution during the course will have to be disclosed, as a resource. If the use of AI is detected but not disclosed, academic offences penalties might be used. The statement of the use of generative AI may be subject to change.

## **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](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.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>).

## **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.

## **STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE**

Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who is going through or has gone through these traumatic events. If you are experiencing or have experienced GBSV (either recently or in the past), you will find information about support services for survivors, including emergency contacts at the following website: [https://www.uwo.ca/health/student\\_support/survivor\\_support/get-help.html](https://www.uwo.ca/health/student_support/survivor_support/get-help.html). To connect with a case manager or set up an appointment, please contact [support@uwo.ca](mailto:support@uwo.ca).

## **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](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.