School of Civil and Environmental Engineering

Term 2, 2021

# CVEN4402 Transport Systems Part I: Network Analysis

## COURSE DETAILS

| | | |
|---|---|---|
| **Units of Credit** | 6 | |
| **Contact hours** | 5 hours per week | |
| **Lecture** | Wednesday 11:00 - 14:00 | Online via Blackboard Collaborate Ultra |
| **Workshop** | Friday 10:00 - 12:00 | Online via Blackboard Collaborate Ultra |
| | Friday 12:00 - 14:00 | Online via Blackboard Collaborate Ultra |
| **Course Coordinator and Lecturer** | Dr Meead Saberi (Office H20 CE104)<br>email: meead.saberi@unsw.edu.au | |
| **Demonstrators** | Shantanu Chakraborty (email: shantanu.chakraborty@unsw.edu.au)<br>Hadi Mansourianfar (email: m.mansourianfar@unsw.edu.au) | |

## INFORMATION ABOUT THE COURSE

This subject covers strategic planning aspects related to transport systems, including transport network-based analysis and modelling techniques. Network representation of transport systems and traffic route choice modelling are the two main broad topics that will be discussed in this subject. Knowledge about different types of transport network solutions and when and where to apply them are important for transport professionals. The subject material focuses on network theory in some depth, and a reasonable mathematical competency as well as the ability to perform computational work will be required to follow this subject. Computer literacy will be helpful but is not essential.

## HANDBOOK DESCRIPTION

See link to virtual handbook

https://www.handbook.unsw.edu.au/undergraduate/courses/2020/cven4402/

## OBJECTIVES

Learning objectives of the course are:

- Describe the fundamentals of transport network analysis
- Apply route choice analysis techniques
- Apply network user equilibrium solution methods
- Justify the importance of transport system concept for analysis and design
- Apply transport network planning techniques

## TEACHING STRATEGIES

| | |
|---|---|
| **Private Study** | • Review lecture material and textbook<br>• Do set problems and assignments<br>• Reflect on class problems and assignments<br>• Download materials from Moodle to supplement notes taken in lecture<br>• Keep up with notices and find out marks via Moodle |
| **Lectures** | • Find out what you must learn<br>• See methods that are not in the textbook<br>• Follow worked examples<br>• Hear announcements on course changes |
| **Workshops** | • Be guided by Demonstrators<br>• Practice solving set problems<br>• Ask questions |
| **Assessments (multiple choice questions, quizzes, tests, examinations, assignments, site visit reports, laboratory reports etc.)** | • Demonstrate your knowledge and skills<br>• Demonstrate higher understanding and problem solving |

## EXPECTED LEARNING OUTCOMES

A successful study of this course will enable students to:

| **Learning Outcome** | | **EA Stage 1 Competencies*** |
|---|---|---|
| 1. | Describe the fundamentals of transport network analysis | PE1.1, PE1.3, PE2.2 |
| 2. | Apply route choice analysis techniques | PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3 |
| 3. | Apply network user equilibrium solution methods | PE1.5, PE2.1, PE2.2, PE2.3 |
| 4. | Justify the importance of transport system concept for analysis and design | PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2 |
| 5. | Apply transport network planning techniques | PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3 |

*Please refer to Appendix A for details of competencies.

For each hour of contact it is expected that you will put in at least 1.5 hours of private study.

## COURSE PROGRAM

**Term 2 2021**

| Week | Date | Topic |
|---|---|---|
| 1 | Wednesday, 2 June | Course Introduction<br>Introduction to Transport Systems, Planning and Networks |
| 2 | Tuesday, 9 June | Routing Algorithms |
| 3 | Tuesday, 16 June | Convexity and Optimization |
| 4 | Tuesday, 23 June | Introduction to User Equilibrium<br>User Equilibrium Assignment Solution Methods |
| 5 | Tuesday, 30 June | Path Based UE Solution Methods |
| 6 | No Lecture | |
| 7 | Tuesday, 14 July | User Equilibrium with Demand Elasticity |
| 8 | Tuesday, 21 July | Stochastic User Equilibrium |
| 9 | Tuesday, 28 July | System Optimal Assignment<br>Dynamic Traffic Assignment |
| 10 | Tuesday, 4 August | Industry guest lecture (TBA) |

Workshops will be held on **Fridays, Week 1-5 and Week 7-10**, and cover the material from the lecture that week. Workshop attendance is expected. Week 6 is the school term break.

| Week | Date | Topic |
|---|---|---|
| 1 | Friday, 4 June | Introduction to Transport Systems, Planning and Networks |
| 2 | Friday, 11 June | Routing Algorithms |
| 3 | Friday, 18 June | Convexity and Optimization |
| 4 | Friday, 25 June | User Equilibrium I |
| 5 | Friday, 2 July | User Equilibrium II |
| 6 | No Workshop | |
| 7 | Friday, 16 July | User Equilibrium with Demand Elasticity |
| 8 | Friday, 23 July | Stochastic User Equilibrium |
| 9 | Friday, 30 July | System Optimal Assignment<br>Dynamic Traffic Assignment |
| 10 | Friday, 6 August | Course Review |

## ASSESSMENT

The final grade for this course will be based on the sum of the scores from the weekly Moodle Quizzes, 2 major assignments and the final examination. For the values of the single components see the table below:

| Assessment | Weighting | Assessment Criteria |
|---|---|---|
| Weekly Moodle Quizzes | 10% | Online weekly quizzes (administered via Moodle) will be used to gauge participation and provide feedback on students understanding of the course material to date. The Moodle quizzes will be based on the material covered in lectures and workshops. They will be open book and are intended to help prepare the students for the final exam. Moodle quizzes will be made accessible for a 72-hour period (6:00PM Thursday - 6:00PM Sunday). Failure to complete a quiz within the accessible time period will result in a mark of zero. |
| 2 Assignments | 40% (20 each) | There will be 2 major assignments throughout the term, each worth 20%. The questions will be based on the material covered in lectures and workshops. The assignments are intended to build on the skills developed in workshop and help prepare the students for the final exam. Assignments will be assessed on the technical merit and consistency of the methodology followed, with consideration given to the clarity of presentation. The assignments sets will be posted on Moodle two weeks before they are due. Digital copies are expected to be submitted online via Moodle by the due date.<br>Late submissions will not be accepted. The students may discuss the problem set questions in general terms, and benefit from the insights of their peers; however, each student must present their own solution. Any duplicate submissions (or parts within) will receive a 0%. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment. The assignment topics and due dates are noted below. |
| Final Exam | 50% | An open-book online final exam will be administered via Moodle at the end of the term. The exam will be cumulative and is intended to assess the student's knowledge of the material covered throughout the entire course. The exam will be assessed on technical accuracy.<br>The performance in the final exam will contribute to 50% of the final grade. In order to pass the course, a student MUST achieve a mark greater than 40% in the final exam to demonstrate a holistic understanding of the course material. If below a 40% is scored on the final exam, the final exam mark will replace your course mark. The lecturer reserves the right to adjust the final scores by scaling if agreed to by the Head of School.<br>Students who perform poorly in the assignments are recommended to discuss progress with the lecturer during the term. |

Supplementary Examinations for Term 2 2021 will be held on Monday 06th September – Friday 10th September 2021 (inclusive) should you be required to sit one. You are required to be available during these dates. Please do not to make any personal or travel arrangements during this period.

## ASSESSMENT OVERVIEW

| Item | Length | Weighting | Learning outcomes assessed | Due date and submission requirements |
|---|---|---|---|---|
| **Quizzes** | | | | |
| Quiz 1 | 3 days | 1% | 1,2 | Sunday, 6 June on 6.00pm on Moodle (week 1) |
| Quiz 2 | 3 days | 1% | 1,2,3 | Sunday, 13 June on 6.00pm on Moodle (week 2) |
| Quiz 3 | 3 days | 1% | 1,2 | Sunday, 21 June on 6.00pm on Moodle (week 3) |
| Quiz 4 | 3 days | 1% | 1,2 | Sunday, 27 June on 6.00pm on Moodle (week 4) |
| Quiz 5 | 3 days | 1% | 1,2,3 | Sunday, 4 July on 6.00pm on Moodle (week 5) |
| Quiz 6 | 3 days | 1% | 2,3,4 | Sunday, 18 July on 6.00pm on Moodle (week 7) |
| Quiz 7 | 3 days | 1% | 2,3,4 | Sunday, 25 July on 6.00pm on Moodle (week 8) |
| Quiz 8 | 3 days | 1% | 2,3,4,5 | Sunday, 1 August on 6.00pm on Moodle (week 9) |
| Quiz 9 | 3 days | 2% | 2,3,4,5 | Sunday, 8 August on 6.00pm on Moodle (week 10) |
| **Major Assessments** | | | | |
| Assignment 1<br>Routing & optimization | 2 weeks | 20% | 1,2,3 | Sunday, 4 July, 6pm on Moodle (week 5) |
| Assignment 2 Network equilibrium models | 2 weeks | 20% | 2,3,4,5 | Sunday, 8 August, 6pm on Moodle (week 10) |
| Final Exam | 2 hours | 50% | 1,2,3,4,5 | TBD (Refer to myUNSW) |

## RELEVANT RESOURCES

All required reading will be provided in the form of lecture notes. Recommended reading (available in the library):

- Urban Transportation Networks by Professor Yossi Sheffi (MIT)
  https://sheffi.mit.edu/book/urban-transportation-networks
  Free PDF download link:
  http://sheffi.mit.edu/sites/sheffi.mit.edu/files/sheffi_urban_trans_networks_0.pdf
- Modelling Transport, Fourth Edition/Juan de Dios Ortúzar, Luis G. Willumsen
  Published Online: http://onlinelibrary.wiley.com/book/10.1002/9781119993308

## DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

https://student.unsw.edu.au/dates

## PLAGIARISM

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

https://student.unsw.edu.au/plagiarism

## ACADEMIC ADVICE

For information about:

- Notes on assessments and plagiarism;
- Special Considerations: student.unsw.edu.au/special-consideration;
- General and Program-specific questions: The Nucleus: Student Hub
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC/SURVSOC/CEPCA

Refer to Key Contacts on the Faculty website available at:
https://www.unsw.edu.au/engineering/student-life/student-resources/key-contacts

**Appendix A: Engineers Australia (EA) Competencies**

*Stage 1 Competencies for Professional Engineers*

| | **Program Intended Learning Outcomes** |
|---|---|
| **PE1: Knowledge and Skill Base** | PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals |
| | PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing |
| | PE1.3 In-depth understanding of specialist bodies of knowledge |
| | PE1.4 Discernment of knowledge development and research directions |
| | PE1.5 Knowledge of engineering design practice |
| | PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice |
| **PE2: Engineering Application Ability** | PE2.1 Application of established engineering methods to complex problem solving |
| | PE2.2 Fluent application of engineering techniques, tools and resources |
| | PE2.3 Application of systematic engineering synthesis and design processes |
| | PE2.4 Application of systematic approaches to the conduct and management of engineering projects |
| **PE3: Professional and Personal Attributes** | PE3.1 Ethical conduct and professional accountability |
| | PE3.2 Effective oral and written communication (professional and lay domains) |
| | PE3.3 Creative, innovative and pro-active demeanour |
| | PE3.4 Professional use and management of information |
| | PE3.5 Orderly management of self, and professional conduct |
| | PE3.6 Effective team membership and team leadership |