School of Civil and Environmental Engineering

Term 1, 2020

CVEN9421 TRANSPORT LOGISTICS ENGINEERING

COURSE DETAILS

Units of Credit	6	
Contact hours	4 hours per week	
Class	Wed, 15:00 – 17:00	Civil Engineering G1 (K-H20-G1)
	Thu, 13:00 – 15:00	Central Lecture Block 5 (K-E19-G06)

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INFORMATION ABOUT THE COURSE

This course is targeted to students in the Faculty of Engineering desiring a deeper understanding of transport logistics engineering. This course will provide an introduction to the mathematical optimization concepts and approaches used in solving large-scale logistical problems encountered in transportation, such as shortest path, network flow and vehicle routing. The expected outcomes of this course are reinforced capability mathematical modelling and in linear and discrete optimization theory as well as the ability implement efficient solution algorithms to solve large-scale transport logistics problems.

HANDBOOK DESCRIPTION

This postgraduate course covers engineering methods applied to transport logistical systems. In this course, the material provided will cover the basics of graph theory, algorithmic complexity and mathematical programming, which are critical tools to solve complex decision-making problems arising in the field of transportation. These advanced methods will be then used to create engineering solutions to manage existing logistical systems as well as answer questions on transport infrastructure needs. Throughout the course, these techniques will be illustrated on challenging transport and logistics problems such as network flows, facility location, vehicle routing, transit systems as well as rail and air logistics. After completing this course, students will have been exposed to efficient methods and their application to solve transport and logistics decision-making problems. The course will use real data for a course project as well as invite leading practitioners to present their expertise on selected topics.

See link to virtual handbook:

https://www.handbook.unsw.edu.au/postgraduate/courses/2020/cven9421/

OBJECTIVES

Learning objectives of the course are:

- To reinforce a student's capability in modelling and apply the concepts learned to the analysis of transport logistics problems.
- To introduce students to fundamental linear and discrete optimization theory and its application to large-scale problems.
- To study and implement efficient and versatile optimization algorithms frequently used by engineers to solve logistical problems.
- Provide a solid foundation in mathematical modelling and advanced optimization approaches needed for their studies in the field of Engineering.
- A respect for ethical practice and social responsibility
  Skills for effective communication

TEACHING STRATEGIES

Private Study	• Review lecture material and textbook • Do set problems and assignments • Reflect on problems and assignments
Lectures	• Find out what you must learn • See methods that are not in the textbook • Follow worked examples
Workshops	• Be guided by Demonstrators • Practice solving set problems • Ask questions
Assessments (multiple choice questions, quizzes, tests, examinations, assignments, hand-in tutorials, etc.)	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving

EXPECTED LEARNING OUTCOMES

Learning Outcome		**EA Stage 1 Competencies**
1.	*Develop an integrative holistic approach to problem solving through systems modelling.*	*PE1.1, PE1.2, PE1.6*
2.	*Ability to select optimal designs from a set of alternatives as a fundamental of engineering problem solving.*	*PE1.1, PE1.2, PE1.6*
3.	*Abstract a complex technical system into quantitative models and/or qualitative frameworks that represent that system*	*PE1.2, PE1.2, PE2.1, PE2.2, PE2.3*
4.	*Use abstracted models and frameworks to evaluate and compare effective design decisions*	*PE1.2, PE1.2, PE2.1, PE2.2, PE2.3*
5.	*Implement optimization methods to improve the performance of various infrastructure systems*	*PE1.2, PE1.2, PE2.1, PE2.2, PE2.3*
6.	*Create a strategy for implementing design decisions.*	*PE1.6, PE2.3*
7.	*Understand the fundamental concepts and principles applied by engineers in advanced systems modelling.*	*PE1.1, PE1.2, PE1.6*
8	*Explore the interdisciplinary nature of integrated real world systems*	*PE1.1, PE1.2, PE1.6*
9	*Apply methods learned to emerging real world engineering problems.*	*PE2.1, PE2.2, PE2.3*
10	*Apply learned skills to their studies.*	*PE2.1, PE2.2, PE2.3*

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

COURSE PROGRAM

Date	Lecture 1 Content	Lecture 2 Content	Major Assessments
17/02/2020 (Week 1)	Introduction to Transport Logistics Engineering	Introduction to Linear and Integer Programming	
24/02/2020 (Week 2)	Network Optimisation Part 1: Routing and Flows	Network Optimisation Part 2: Mathematical Programming	
02/03/2020 (Week 3)	Linear Programming Part 1: Theory	Linear Programming Part 2: Simplex Algorithm	
09/03/2020 (Week 4)	The Transportation Problem	In-class Quiz	In-class Quiz (1h)
16/03/2020 (Week 5)	Integer Programming Part 1: Theory	Integer Programming Part 2: Branch and Bound Algorithm	In-class Quiz Review Assignment Release
23/03/2020 (Week 6)	*No lecture this week*		
30/03/2020 (Week 7)	Traffic Signal Modelling and Control	The Knapsack Problem	
06/04/2020 (Week 8)	Vehicle Routing Problem Part 1: Modelling	Vehicle Routing Problem Part 2: Subtour Generation Algorithm	
13/04/2020 (Week 9)	Guest Lecture	Practice Problems (online)	Assignment Due
20/04/2020 (Week 10)	Assignment Review	Course Review and Q&A	Assignment Review

ASSESSMENT

Assessment is based on weekly Moodle quizzes an in-class quiz, an assignment and a final written examination:

- Moodle quizzes are worth 10% of the course mark (10 quizzes, worth 1% each)
- The in-class quiz is worth 20% of the course mark,
- The assignment is worth 20% of the course mark,
- The final written examination is worth 50% of the course mark.

The in-class quiz and the assignment are assessed on the technical merit and consistency of the methodology followed. Attention to the detail and demonstrated initiative in experimentation with concepts learned will be rewarded. Late assignment submissions will not be accepted.

The final written examination will be in the conventional closed book format covering all topic areas. The formal exam scripts will not be returned. The lecturer reserves the right to adjust the final scores.

The pass mark in this course is 50% overall, however, students must score at least 40% in the final examination in order to qualify for a Pass in this course.

Supplementary Examinations for Term 1 2020 will be held on Monday 25th May – Friday 29th May (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.

PENALTIES

Late submissions will be penalised at the rate of 10% per day after the due time and date have expired.

ASSESSMENT OVERVIEW

Item	Length	Weighting	Learning outcomes assessed	Release Date	Due date	Deadline for absolute fail	Marks returned
Moodle Quizzes							
Quiz 1 (week 1)	24h	1%	1,2,3	Thu, 20th Feb 16:00	Fri, 21st Feb 16:00	Fri, 21st Feb 16:00	Fri, 21st Feb 16:00
Quiz 2 (week 2)	24h	1%	1,2,3	Thu, 27th Feb 16:00	Fri, 28th Feb 16:00	Fri, 28th Feb 16:00	Fri, 28th Feb 16:00
Quiz 3 (week 3)	24h	1%	1,2,3	Thu, 5th Mar 16:00	Fri, 6th Mar 16:00	Fri, 6th Mar 16:00	Fri, 6th Mar 16:00
Quiz 4 (week 4)	24h	1%	1,2,3,4	Thu, 12th Mar 16:00	Fri, 11th Mar 16:00	Fri, 11th Mar 16:00	Fri, 11th Mar 16:00
Quiz 5 (week 5)	24h	1%	1,2,3,4	Thu, 19th Mar 16:00	Fri, 20th Mar 16:00	Fri, 20th Mar 16:00	Fri, 20th Mar 16:00
Quiz 6 (week 6)	24h	1%	2,3,4,5	Thu, 26th Mar 16:00	Fri, 27th Mar 16:00	Fri, 27th Mar 16:00	Fri, 27th Mar 16:00
Quiz 7 (week 7)	24h	1%	2,3,4,5	Thu, 2nd Apr 16:00	Fri, 3rd Apr 16:00	Fri, 3rd Apr 16:00	Fri, 3rd Apr 16:00
Quiz 8 (week 8)	24h	1%	3,4,5,6,7	Thu, 9th Apr 16:00	Fri, 10th Apr 16:00	Fri, 10th Apr 16:00	Fri, 10th Apr 16:00
Quiz 9 (week 9)	24h	1%	3,4,5,6,7	Thu, 16th Apr 16:00	Fri, 17th Apr 16:00	Fri, 17th Apr 16:00	Fri, 17th Apr 16:00
Quiz 10 (week 10)	24h	1%	3,4,5,6,7	Thu, 23rd Apr 16:00	Fri, 24th Apr 16:00	Fri, 24th Apr 16:00	Fri, 24th Apr 16:00
Major Assessments							
In-class Quiz	1 hour	20%	1,2,3,4,5,6,7, 8	Thu, 12th Mar 13:30	Thu, 12th Mar 14:30	N/A	Wed, 18th Mar 15:00
Assignment	3 weeks	20%	3,4,5,6,7,8,9, 10	Wed, 18th Mar 17:00	Wed, 15th Apr 15:00	Wed, 22nd Apr 15:00	Wed, 22nd Apr 15:00
Final Exam	2 hours	50%	1,2,3,4,5,6,7, 8,9,10		TBD (Refer to myUNSW)	N/A	N/A

All assessments besides the final exam must be submitted on Moodle in PDF format.

RELEVANT RESOURCES

Textbooks (**recommended as reference**)

- Bertsimas, Dimitris, and John N. Tsitsiklis. *Introduction to linear optimization*. Vol. 6. Belmont, MA: Athena Scientific, 1997.
- Schrijver, Alexander. *Theory of linear and integer programming*. John Wiley & Sons, 1998.
- Fourer, Robert, Gay, David M. and Brian W. Kernighan. *AMPL: A Modeling Language for Mathematical Programming,* Second edition, ISBN 0-534-38809-4.
- AMPL Book Resources (Chapters and examples files): https://ampl.com/resources/the-ampl-book/
- Larson, Richard C., and Amedeo R. Odoni. *Urban Operations Research*. Prentice Hall, 1981. Available at: http://web.mit.edu/urban_or_book/www/book/

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

(Formerly known as Common School Information)

For information about:

- Notes on assessments and plagiarism,
- School policy on Supplementary exams,
- Special Considerations: student.unsw.edu.au/special-consideration
- Solutions to Problems,
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC.

Refer to Academic Advice on the School website available at:

https://www.engineering.unsw.edu.au/civil-engineering/student-resources/policies-procedures-and-forms/academic-advice

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