The Hong Kong Polytechnic University

Subject Description Form

Subject Code	CSE6015
Subject Title	Transportation Optimization and Simulation Methods
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Students should have fundamental knowledge about mathematics and computation methods.
Objectives	This subject is intended to introduce a broad range of optimization and simulation methods for construction and transportation applications; and equip students with knowledge of applying the skills learned in this class to model and solve real-world problems in construction and transportation.
Intended Learning Outcomes	Upon completion of the subject, students will be able: (a) to appreciate the need for a systematic approach for modeling different applications in construction and transportation; (b) to equip students with a good understanding of the fundamentals in formulating and solving real-world problems in the field of construction and transportation; (c) to demonstrate the capability to apply the skills learned in this course to model and solve real-world construction and transportation problems; (d) to demonstrate the capability to write a technical report/paper and communicate the results of their solution approach to other engineering professionals
Subject Synopsis/ Indicative Syllabus	This subject covers the following contents: 1. Fundamentals Basic principles in systems analysis applied to construction and transportation; Basic theory of optimization and simulation methods; Unconstrained and constrained optimization problems; Introduction to stochastic and multi-objective optimization problems 2. Network Flow Optimization Shortest path problems; vehicle routing problems; Traffic assignment problems (user equilibrium versus system optimal); Stochastic traffic assignment problems; Traffic assignment algorithms 3. Network Design Problems Traffic paradoxes (Braess paradox, stochastic paradox, capacity paradox, etc.); Game theory; Bi-level mathematical programs; Deterministic and stochastic network design problems; Iterative-optimization-assignment method; Sensitivity-based analysis method; Global optimization method; Metaheuristics

	4. Complex System Problems Agent-based modeling; System dynamics; System of systems; Network theory 5. Advanced Topics Supernetworks; Dynamic traffic assignment; Transit assignment; Reliability and vulnerability analysis
Teaching/Learning Methodology	The subject is delivered mainly using lectures which are focused on optimization methods for formulating and solving real-world construction and transportation problems. The lectures need to be supplemented by substantial self-study after class by students of reference materials and other up-to-date technical reports/journal papers recommended by the lecturer(s). The students need to complete a set of assignments and an individual project and presentation.
Assessment Methods in Alignment with Intended Learning Outcomes	

<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="4">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td></tr>
<tr><td>1. Assignments</td><td>50%</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>2. Project Report and Presentation</td><td>50%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100 %</td><td></td><td></td><td></td><td></td></tr>
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The students will be assessed with two components, i.e. 1. assignments, 2. Written individual project report and oral presentation at the end of the semester. The students will be required to conduct extensive reading after the lecture to complete a set of assignments. Each assignment is designed to cover a particular technical aspect of data analysis. Moreover, an individual project is designed to assess the students' understanding on the critical assessment and effective communication of the results of data analysis in solving real world problems. Hence, the students are considered to be highly effective in achieving the intended learning outcomes a), b), c) and d).

Student Study Effort Expected	Class contact:	
	▪ Lectures	39 Hrs.
	▪ Examination	
	Other student study effort:	
	▪ Reading of reference materials	26 Hrs.
	▪ Assignments	30 Hrs.
	▪ Individual project	40 Hrs.
	Total student study effort	135 Hrs.

Reading List and References	• **Books** (1) Anderson, D.R., Sweeney, D.J., Williams, T.A., Camm, J.D., Martin, K., 2012. An Introduction to Management Science: Quantitative Approaches to Decision Making. Revised 13th Edition, South-Western Cengage Learning, Mason, OH, USA. (2) Ahuja, R.K., Magnanti, T.L., Orlin, J.B., 1993. Network Flows, Prentice Hall. (3) ReVelle, C.S., Whitlatch, E.E., Wright, J.R., 2004. Civil and Environmental Systems Engineering, 2nd Edition, Prentice Hall. (4) Sheffi, Y., 1985. Urban Transportation Networks: Equilibrium Analysis with Mathematical Programming Methods, Prentice Hall. (5) Bell, M.G.H., Iida, Y., 1997. Transportation Network Analysis, John Wiley & Sons, Inc. (6) Nagurney, A., 1999. Network Economics: A Variational Inequality Approach, Kluwer Academic Publishing. (7) Nagurney, A., Dong, J., 2002. Supernetworks Decision-Making for the Information Age, Edward Elgar Publishing Limited, Northampton, Massachusetts, USA. (8) Wilensky, U., Rand, W., 2015. An Introduction to Agent-Based Modeling: Modeling Natural, Social, and Engineered Complex Systems with NetLogo, The MIT Press. • **Journals** (1) Transportmetrica A: Transport Science, http://www.tandfonline.com/toc/ttra21/current (2) Transportmetrica B: Transport Dynamics, http://www.tandfonline.com/loi/ttrb20 (3) Transportation Research Part B: Methodological, https://www.journals.elsevier.com/transportation-research-part-b-methodological (4) Transportation Research Part C: Emerging Technologies, https://www.journals.elsevier.com/transportation-research-part-c-emerging-technologies/ (5) Transportation Research Part E: Logistics and Transportation Review, https://www.journals.elsevier.com/transportation-research-part-e-logistics-and-transportation-review/ (6) Travel Behaviour and Society, https://www.journals.elsevier.com/travel-behaviour-and-society/ (7) International Journal of Sustainable Transportation, http://www.tandfonline.com/loi/ujst20 (8) Journal of Computing in Civil Engineering, http://ascelibrary.org/journal/jccee5 (9) Environmental Modelling & Software, https://www.journals.elsevier.com/environmental-modelling-and-software (10) Computer, Environment and Urban Systems, https://www.journals.elsevier.com/computers-environment-and-urban-systems/