

CE409 TRANSPORT ENGINEERING

Coordinator: John Polak (Room 616), j.polak@imperial.ac.uk

Status: Environmental Elective

Lecturers: John Polak (JWP)
Robert Noland (RBN)

Structure: 39 lectures, 12 tutorials, 3 hours of computing

Links: see below

Introduction

The module consists of lectures, tutorials and computer laboratory sessions. Each group of 2 or 3 lectures has an associated tutorial or laboratory session in which students work independently or in groups on exercises related to the lectured material. Each lecture is accompanied by a printed handout which briefly summarizes the material contained in the lecture. From time to time, these handouts are supplemented by additional background reading, as appropriate.

Aims

Civil engineers play a central role in the planning and operation of transport systems. The aim of this module is to provide students with an introduction to the key concepts and methods used in current practice, and to help them develop an awareness of the broader context within which transport engineering is undertaken. Whilst the module focuses principally on the problems of urban road transport, many of the principles and methods have much wider application in the analysis of transport systems.

Links with Other Course Modules

The module draws on a number of earlier modules including CE102 Mathematics, CE201 Mathematics, CE304 Systems Engineering, CE 305 Engineering Economics and Management, CE 312 Highway and Traffic Engineering and CE 313: Engineering Geomatics. There are also links with CE 411 Systems Analysis and CE 412 Management.

SYLLABUS

The module covers a number of inter-related areas of transport planning and engineering, including:

1. Introduction and overview (JWP): The role of transport and its social and economic context (2 lectures)
2. Fundamental concepts (JWP/RBN): Travel demand, transport networks and zones, congestion and other externalities, accessibility, principles of evaluation and appraisal, travel demand management (10 lectures/tutorials)
3. Modelling travel demand (JWP): Utility and travel choice, random utility theory, discrete choice models, estimation and application of the logit model, extensions of the basic logit model. (10 lectures/tutorials)
4. The 4-stage transport planning model (JWP): Trip generation, trip distribution, mode choice, traffic assignment, extensions to the 4-stage model including modelling the timing of travel. (8 lectures/tutorials).

5. Network equilibrium methods (JWP): Equilibria involving demand, performance and supply, computation of simple network equilibria, application of the Frank-Wolfe algorithm for general networks, static and dynamic traffic equilibrium formulations. (6 lectures/tutorials)
6. Environmental impacts of transport (RBN): Relationships between transport and the environment, air pollution and air quality management, climate change, prediction and mitigation of traffic noise, land use/transport interactions (13 lectures/tutorials).

Coursework and Submission Dates

Coursework 1: *Transport Policy Essay* (due week 8 with presentation on week 9).

This coursework assesses student's understanding of the basic principles of transport systems analysis and planning, as covered in section 1 and 2 of the syllabus.

Coursework 2: *Travel Demand Modelling* (due 30 week 21). This coursework assesses student's understanding of the principles and practice of discrete choice modelling as covered in sections 2 and 3 of the syllabus.

Coursework 3: *4-stage Modelling and Network Equilibrium* (due week 25). This coursework assesses student's understanding of the principles and application of trip distribution modelling and equilibrium assignment, as covered in sections 4 and 5 of the syllabus.

Coursework 4: *Air Quality and Noise Calculations* (due 26 March 2004). This coursework assesses student's understanding of techniques used for calculating air quality and noise impacts as covered in section 6 of the syllabus.

You will be given approximately 3-4 weeks (real time) to complete each item of coursework. Lecturers will endeavour to return marked coursework within 4 weeks of submission. Lecturers will provide worked solutions to the coursework exercises.

Assessment

A 3-hour written examination at the end of the session. Examination paper will comprised of 8 questions, in two sections; Section 1 covering items 3-5 of the syllabus and Section 2 covering items 1, 2 and 6. Rubric: "Answer five questions, selecting at least one question from each section."

Recommended Textbooks/Reading

BEN-AKIVA, M.E. AND LERMAN, S.L. (1985) *Discrete Choice Modelling*, MIT Press, Cambridge MA.

BUCHANAN, C. *et al.*, (1963) *Traffic in Towns: A Study of the Long Term Problems of Traffic in Urban Areas*, Her Majesty's Stationery Office, London.

DOWNS, A. (1992) *Stuck in Traffic*, Brookings Institution, Washington.

Institution of Highways and Transportation (1997) *Transport in the Urban Environment*, Institution of Highways and Transport, London.

Institution of Highways and Transportation (1996) *Guidelines for Developing Urban Transport Strategies*, Institution of Highways and Transport, London.

Highways Agency (2000) *Design Manual for Roads and Bridges* (Vols. 10-13), <http://www.official-documents.co.uk/document/ha/dmrb/index.htm>

MANHEIM, M.L. (1979) *Fundamentals of Transportation Systems Analysis Vol 1*, MIT Press, Cambridge MA.

ORTUZAR, J. DE D. AND L.G. WILLUMSEN (1994) *Modelling Transport*, 2nd edition, Wiley, Chichester

PAPACOSTAS, C.S. AND P.D. PREVEDOUROS (1993) Transportation Engineering and Planning, *Prentice Hall, Englewood Cliffs*.
Royal Commission on Environmental Pollution (1994) Transport and the Environment, *Cm 2674, HMSO, London*.

Learning Outcomes

At the end of this module students are expected to:

- Be familiar with the nature of transport engineering and planning problems, including the relationship between transport and the environment (assessed via examination).
- Understand and have gained experience in using the principal methods of analysing travel demand and network performance and their interaction (assessed via examination and coursework reports)
- Have acquired experience in the use of a range of commercial transport planning and engineering software (assessed via examination and coursework reports)
- Appreciate the range of transport policy measures currently used in practice and understand how to go about assessing their likely effects (assessed via examination).