Planning and Management of Transportation (250409)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA)
Credits	6.0 ECTS
Programs	MÀSTER UNIVERSITARI EN ENGINYERIA DE CAMINS, CANALS I PORTS (pla 2012) MÀSTER UNIVERSITARI EN ENGINYERIA DE CAMINS, CANALS I PORTS (pla 2012) MÀSTER UNIVERSITARI EN MOBILITAT URBANA (pla 2020) PARS: ENGINYER/A DE CAMINS, CANALS I PORTS (pla 2022)
Course	2024/25

Main teaching language at each group

- Group 10EN1 English (Q1)
- Group 10EN2 English (Q2)

Faculty

Responsible Faculty: Francesc Robusté Antón
Faculty: Hugo Badia Rodríguez, Miguel Angel Estrada Romeu, Pere Macias Arau, Margarita Martínez Díaz, Adriana Haydee Martinez Reguero, Josep Mercadé Aloy, Francesc Robusté Antón, Elisabeth Roca Bosch

Objectives of Education

Students will acquire an understanding of the design and operation of modal interchange transport infrastructure, including ports, airports, rail terminals and logistics centres.

Upon completion of the course, students will be able to:

Conduct studies of transport engineering and planning, transport types and functions, urban transport, management of public services, demand, costs, logistics, and financing of transport infastructure and services;
Analyse and interpret the regulation and impact of infrastructure and their repercussions for sustainable development, taking into account economic, environmental, social and cultural factors;
Plan, manage and operate civil engineering infrastructure.

Transport planning: Multi-modal transport and mobility; Transport systems and territorial impact; Hierarchy of transport systems; Physical limitations of transport systems: Capacity and performance; Impacts of transports systems: Environmental, physical, social, cultural, economic; Transport systems in urban areas; Localisation of economic activities; Infrastructure networks; Branch and mesh networks; Decision-making in transport and regional planning; Objectives, efficiency, sustainability, transport planning and urban planning; Journey time and short-term economic effects; Geographical information, characterisation of infrastructure and land use; Sampling and surveys; Demand modelling, econometric models; Public and private investment models, risk quantification, concessions, participating interests and management, shadow tolls; Tariff structure and profit; Management and operation of transport infrastructure and services; Private vehicles, parking, rates, service control, urban and inter-urban road infrastructure, control and ICTs; Road freight and logistics hubs; Maritime transport systems and port terminals; Air transport and airport terminals; Rail transport and rail terminals; Intermodal transport systems, international routes.

Students will acquire a good understanding of the key planning, design and management issues of any transportation/mobility system, including appraisal, economics, optimization and customer behavior issues. Transversal concepts such as capacity, performance, operations, management, planning, appraisal, service, etc. are common to all the classical transportation modes like railways, roads, ports, airports, public transportation, terminals, traffic, pedestrians, logistics and other urban mobility modes (personal mobility devices, bicycles, etc.). The territorial and urban substratum, as well as the environmental and social are very present in a transversal way.

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	27.96 h	51.78 %
	Medium group	13.02 h	24.11 %
	Laboratory classes	13.02 h	24.11 %
	Guided Activities	0.0 h	0.00 %
Self Study		96.0 h	

Contents

Theoretical classes

Introduction to the subject: contents, evaluation, readings, classes, instructors, references, etc.
Transportation system.
Location and Linear Mathematical Programming.
Operations - trajectories. (Only Spring Term).
Operations - queues. (Only Spring Term).
Geometrical probability in planning and optimization. (Only Fall Term).
Networks and accessibility.
Transportation problems and solution generation. (Only Fall Term).
Transportation microeconomics. (Only Spring Term).
Funding. Costs and financing. Demand risk and cost. Private financing of infrastructure. PPPs. Concept of project finance. Structure of a Company vehicle project. Type of debt and equity. Risk assessment. Pricing (pricing) infrastructure and services. Funding. Value pricing. Service pricing. Marginal cost pricing. Regulatory Law of Contract grant of Public Works. Models of funding and management of railways, ports and airports in Spain and the European Union.
Demand. Information (static and dynamic). Polls PR and PD. Review of models of 4 stages: generation / attraction, distribution, modal split, assignment routes. Balancing network: user deterministic (Wardrop) and stochastic (SUE) system. Induced demand. Ramp factors.
Planning. Case: L9 metro line in Barcelona.
Appraisal. Cost-benefit analysis (CBA), decision analysis in the presence of uncertainty (DA). Multicriteria analysis (weighted averages, analytic hierarchy process (AHP), systemic analytical process (ANP). Agents Matrix-effects. Effects of infrastructure and transport services (direct, indirect, induced and intangibles). Reliability and evaluation risk (RPRA). decisions under uncertainty. Arrays IA.
Logistics - Vehicle routing.
Logistics - City logistics.
Logistics - Supply Chain Management. (Only Fall Term).
Bus network layout & operation. (Only Spring Term).
Traffic theory. (Only Spring Term).
Taxicabs, ridesharing and MaaS.
Concessions (PPP). Toll motorway. Revenue/traffic forecasts. (Only Fall Term).

Case studies

Case 1: Railway infrastructure planning in Spain.
Case 2: Terminal T1, BCN airport. Guest: Francisco Gutiérrez.
Case 3: Tramway link in Barcelona. Guest: Oriol Altisench.
Case 4: Bus network layout & operation in Barcelona and Lleida.
Case 5: Variable speed limits in Barcelona. (Only Fall Term).

Case 6. Road safety.
Case 7: Electro-mobility. (Only Fall Term).
Case 8: Air quality and mobility.
Case 9: Mobility 4.0.
Case 10: Apps and business models in smart mobility. (Only Fall Term).
Case 11: Mobility in developing cities/countries.
Case 12: Barcelona port and BEST container terminal
Case 13: Economics of quality in road pavements.
Case 14: Social issues and participation.

Activities

Project assignment

Dedication

4h

Teaching Methodology

The teaching methodology of this subject is based on a first block of in-depth analysis of key concepts in the strategic, tactical and operational planning of transport systems (infrastructures and services) and their management and operation. The territorial substratum in its economic perspective and the city as a physical substratum of mobility are very present as they are inseparable aspects of the same phenomenon.

The sessions of the first block "Theory" are based on the expository method supported by Powerpoint presentations and Word files. We will see simple quantitative methodologies for decision-making in transport systems based on user benefits and behavior, system performance (quality of service) and economic, financial, social and environmental aspects.

The second block "Cases" include several case studies, where the professional and real applications of the analysis methodologies are reflected in specific examples. Cause-effect relationships will be identified between system actors, management strategies by sectors and business models, functional, financial and social equity balances, as well as administrative constraints and regulations to assess social profitability or any specific stakeholder profitability of an investment in transport.

Material: Powerpoints that include videos and exercises, course notes and complementary readings.

Vertical contents: Transportation Planning and Management principles and applications. Transversal concepts: Economic and Social Territory, Sustainability, Environment, Energy, Accessibility, trade-off Supply vs Demand, trade-off Global vs Local, Functionality, TSM, etc.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

Grading Rules

(*) The evaluation calendar and grading rules will be approved before the start of the course.

The evaluation of the subject consists of several inputs, multiple choice exams (quizzes) about the concepts of the classes, a "modeling" exam with several conceptual exercises (because of the possible "luck factor" for this kind of exam, Modeling exam has a re-sit chance), and a course report (usually individual, short of 6-8 pages and following a template).

This subject evaluation rules comply with the 2023 UPC general evaluation rules: (1) the final grade must be a weighted average, (2) minimum grade conditions cannot be established to consider the results of the rest, and (3) in any evaluation and revaluation, only the highest grade is kept.

Quizzes (Q): two short multiple-choice exams of the concepts given in class (and written on the Powerpoints and Words used as course notes). Usually, 30 questions (each quiz) with 4 possible answer (A, B, C, D).

Only one answer is correct. Wrong answer subtracts ¼ of the point of each question. The quiz grade is the arithmetic average of the two quizzes (equal weight): Q = (Q1 + Q2)/2. We always put several past exams (in blank so that the students can answer them, and with the solution) in Atenea intranet for the subject.

Exam of modeling (M): usually 4 or 5 exercises similar to the ones solved in class and that appear on the Powerpoints and Words used as course notes. We always put several past exams (in blank so that the students can answer them, and with the solution) in Atenea intranet for the subject. Because of the possible "luck factor" for this kind of exam, the Modeling exam has a re-sit chance at the end of the subject. We always consider the best grade obtained in both exams. We always put several past exams (in blank so that the students can answer them, and with the solution) in Atenea intranet for the subject.

Exam grade (E) is the arithmetic average (equal weight) of the quiz (two quizzes) and the modeling exam: E = (Q + M)/2.

Report (R) is an individual report among a list of topics. It has a deadline (at midnight of several days after the final exam in a proper "drop-box" in Atenea intranet) and the reports must follow a template (to avoid "anonymous internet reports"). The reports are short (6-8 pages) with a structure that is well defined in the instructions. The report helps to improve the exam grade. Plagiarism in the report is checked with Urkund. The reports grade considers the number of students working on the report (usually one, but sometimes there are two students that want to work on the same topic and they would rather work together), the percentage of plagiarism given by Urkund, and the personal effort involved in the report, especially accounting for modeling or data analysis efforts (surveys, measures, model calibration, etc.).

Reports are volunteer. If a student does not deliver a report, his/her Grade = E (the exam grade). The same happens when (very strange) the report grade is less than the exam grade (R<E): in this case, the final grade is the Exam (E).

For those who deliver a report, the final grade is Grade = (7E+2R)/9. If R<E, Grade = E.

Official grades of all passing grades (greater than or equal to 5) will be magnified following the re-escalating algorithm of the Civil Engineering School (5% A+, 30% A, 30% B, 35% C). "Curricular evaluation" for grades greater than or equal to 4 (applied by the Civil Engineering School for MECCP students).

Test Rules

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

Office Hours

Most of the questions/answers take place by email or at the beginning or end of the classes, or during the breaks. Scheduled appointments by email.

Bibliography

Basic

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- Dupuy, G. El urbanismo de las redes: teorías y métodos. Barcelona: Oikos-Tau : Colegio de Ingenieros de Caminos, Canales y Puertos, 1998. ISBN 8428109370.
- Jara-Diaz, S. Transport economic theory. Oxford: Elsevier, 2007. ISBN 9780080548999.
- Meyer, M.D.; Miller, E.J. Urban transportation planning: a decision-oriented approach. 2a ed. New York: McGraw-Hill, 2001. ISBN 0072423323.
- Ortúzar, J.D.; Willumsen, L.G. Modelling transport. 4th ed. Chichester: John Wiley & Sons, 2011. ISBN 9780470760390.
- Sheffi, Y. Urban transportation networks: equilibrium analysis with mathematical programming methods. Englewood Cliffs, NJ: Prentice-Hall, 1985. ISBN 0139397299.

Complementary

- de Neufville, R. Applied systems analysis: engineering planning and technology management. New York: McGraw-Hill, 1990. ISBN 0070163723.
- Gatti, S. Project finance in theory and practice: designing, structuring, and financing private and public projects. Waltham: Academic Press, 2012. ISBN 9780124157538.
- Gramlich, E. M. Infrastructure Investment: A review essay. Journal of Economic Literature, 1994.
- Izquierdo, R.; Vassallo, J.M. Nuevos sistemas de gestión y financiación de infraestructuras de transporte. Madrid: Colegio de Ingenieros de Caminos, Canales y Puertos, 2004. ISBN 8438002897.
- Manheim, M.L. Fundamentals of transportation systems analysis: Vol 1. basic concepts. Cambridge, MA: The MIT Press, 1979. ISBN 0262131293.
- Nicholson, W.; Snyder, C. Microeconomic theory: basic principles and extesions. 12th ed. Cengage Learning, Inc, 2016. ISBN 9781305505797.
- Wood, P.R. Project finance, securitisations, subordinated debt. 2nd ed. London: Sweet & Maxwell, 2007. ISBN 9781847032119.