Course guide
250ST2121 - 250ST2121 - Public Transport

Last modified: 16/05/2023

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: MASTER'S DEGREE IN SUPPLY CHAIN, TRANSPORT AND MOBILITY MANAGEMENT (Syllabus 2014). (Optional subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Estrada Romeu, Miguel Angel

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CETM1. Knowledge of the design, planning of transport infrastructure and modal terminals, such as highways, railways, ports, airports, railway stations and transport logistics centers exchange.
CETM3. Knowledge for planning, management and operation of transportation systems and mobility, ability to analyze service levels to users, operating costs and environmental and social such as mass transit, and private vehicle traffic impacts, air transport, sea transport, intermodal transport and urban mobility.
CESC4. Know and apply the techniques of modeling, simulation and optimization to solve the problems involved the design and management of supply chains.
CETM2. Understanding and quantifying capacity fundamentals transport systems and mobility determine the safety, quality and sustainability of transport infrastructure and optimizing the operation of these systems.

Transversal:
CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Basic:
CB 8. (ENG) Que els estudiants siguin capaços de d'integrar coneixements i enfrentar-se a la complexitat de formular judicis a partir d'una informació que, essent incompleta o limitada, inclogui reflexions sobre les responsabilitats socials i ètiques vinculades a l'aplicació del seus conexicements i judicis.
CB 9. (ENG) Que els estudiants sàpiguen comunicar les seves conclusions i coneixements (i darrers raonaments que els sostentin), a públics especialitzats i no especialitzats de manera clara i sense ambigüitats.

TEACHING METHODOLOGY

The course consists of 3.0 hours per week of classroom activity (large size group).

The lectures are divided in two parts. The first part (2.0 hours) is devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises. Theory Class structure (2 first hours):
- Topic. Objectives + References + Conclusions.
- Background and description (PPT): main concepts, main formulas, tables, graphics.
- Professional case / application (simplified).
- Science and principles (blackboard and/or PPT).

The last 1 hour is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives. Projects and Homework: cases / readings / exercises / field work

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

The course will be taught completely in English

LEARNING OBJECTIVES OF THE SUBJECT

Provide an overall knowledge of Public Transport Systems.Transport-system analysis and evaluation tools, such as operations research, operations analysis, demand estimation, transport economics, evaluation of alternatives, transport system modelling and route assignment; Causal and quantitative operation of public transport systems and behaviour of the various agents that system involves (users, operators and administration/society); Design, functioning and operation of transport terminals and infrastructure; Management of the resources necessary to operate transport services; Mobility patterns of passengers and their relationship to ICTs; Intermodal passenger terminals in urban public transport systems,.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	12.00
Self study	80,0	64.00
Hours large group	30,0	24.00

Total learning time: 125 h

CONTENTS

Introduction/Introducció/Introducción

Description:
Schedule, lecturers, organization of the subject. Research in Public Transport.
Introduction to public transport. User mindset and sociology of Urban Mobility. Mobility patterns.

Full-or-part-time: 1h
Theory classes: 1h

Characterization of Public Transport Systems /Caraterització de sistemes de transport públic /Caracterización sistemas de transporte público

Description:
Characterization of Public Transport Systems. Definitions and components. Means. Characterization and vehicle movement. Energy. Capacity. Performance. Effectiveness and efficiency. Indicators. Quality in colective public transport. Definition of quality. Indicators. Customers satisfaction. Perception and control. Public transport Microeconomy. Transportation costs. Inferior good. Social costs. Diseconomies of private vehicles. Founding needs. Demand quantification. Elasticities. Discrete models. Economic and social returns. Indicators of mobility. Socio-economic indicators of profitability. Indicators of financial profitability.

Full-or-part-time: 3h
Theory classes: 3h

Public transport network design (I). One corridor

Description:
Public transport network design (I). Strategic, tactic and operational process. Review of methodologies based on mathematical programming, graph theory (network cohesion). Continous approximations method. One corridor.

Related activities:
Homework I

Related competencies :
CETM3. Knowledge for planning, management and operation of transportation systems and mobility, ability to analyze service levels to users, operating costs and environmental and social such as mass transit, and private vehicle traffic impacts, air transport, sea transport, intermodal transport and urban mobility.

Full-or-part-time: 3h
Theory classes: 3h

Public transport network design (II). Network

Description:
Public Transport network design (II). Continuous approximations method. Network design.

Related activities:
Homework II

Related competencies :
CETM2. Understanding and quantifying capacity fundamentals transport systems and mobility determine the safety, quality and sustainability of transport infrastructure and optimizing the operation of these systems.
CETM1. Knowledge of the design, planning of transport infrastructure and modal terminals, such as highways, railways, ports, airports, railway stations and transport logistics centers exchange.

Full-or-part-time: 6h
Theory classes: 6h

Control and regularity

Description:
Service performance metrics: regularity (headway adherence) and punctuality (timetable adherence). Introduction to the unstable motion of public transport vehicles. Modeling approach. Control strategies to improve regularity and punctuality: slacks, speed profile control and traffic light priority. Case study in bus route H6 in Barcelona.

Related activities:
Homework III

Related competencies :
CESC4. Know and apply the techniques of modeling, simulation and optimization to solve the problems involved the design and management of supply chains.
CB 8. (ENG) Que els estudiants siguin capaços de d'integrar coneixements i enfrentar-se a la complexitat de formular judicis a partir d'una informació que, essent incompleta o limitada, inclogui reflexions sobre les responsabilitats socials i ètiques vinculades a l'aplicació del seus conexicements i judicis.

Full-or-part-time: 3h
Theory classes: 3h

On-demand transport services

Description:
On-demand transport (demand-responsive transport). Flexible design of public transport services. Introduction of flexible stop patterns, flexible layout and flexible departure time. Comparative analysis in terms of operating cost and user performance. Integration in MaaS platforms. Case study in Barcelona Metropolitan Area.

Specific objectives:
Homework IV

Related competencies :
CESC4. Know and apply the techniques of modeling, simulation and optimization to solve the problems involved the design and management of supply chains.
CETM3. Knowledge for planning, management and operation of transportation systems and mobility, ability to analyze service levels to users, operating costs and environmental and social such as mass transit, and private vehicle traffic impacts, air transport, sea transport, intermodal transport and urban mobility.

Full-or-part-time: 3h
Theory classes: 3h

Battery electric buses

Description:
Introduction to electromobility and battery performance. Design of electric bus system. Performance and operating cost metrics. Optimization procedure. Case study in Barcelona H16 route.

Related activities:
Homework V

Related competencies :
CETM1. Knowledge of the design, planning of transport infrastructure and modal terminals, such as highways, railways, ports, airports, railway stations and transport logistics centers exchange.

Full-or-part-time: 3h
Theory classes: 3h

Guided public transport

Description:
Guided public transport (I). Metro. Commuter rail. Types of exploitation. CTC. Fixed stations management and premises (telecommander). Light Rail Transit. Tramway. People Movers. Guided public transport (II). Capacity and operation.

Related activities:
Homework VI

Full-or-part-time: 3h
Theory classes: 3h

Coupled Traffic and mass transit management. Vickrey's model and Daganzo-Geroliminis' model (3dMFD).

Description:
Revision of the Vickrey's model to deal with congestion episodes in cities. Inclusion of the Macroscopic Fundamental Diagram to characterize traffic states in the city. OPtimal fare structure for passenger cars. Extension of MFD for a coupled transit-traffic perspective.

Related competencies :
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Full-or-part-time: 3h
Theory classes: 3h

Fare structure and Revenue Management

Description:
Pricing and financing policies. Economy of exploitation. Perception systems and technologies. Tickets. Zoning. Fares. Social discounts. Level of price integration. Level of coberage. Fundings. Sharing the revenues of multioperator tickets. Transport Authority. Functions, competences, funding, clearing house. Revenue management. Demand segmentation. Overbooking strategy.

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Full-or-part-time: 3h
Theory classes: 3h

Project-based learning sessions

Description:
The project consists of Managing competitive mobility services in a given city to be chosen from 16 available candidate cities. The project is aimed at minimizing the total social cost Z (PV and bus users, operational agency cost, infrastructure cost and external cost) in this city, managing the following policy drivers: the optimal congestion fare for private car users and the optimal length of a new bus network.
Students will apply the concepts taught during the course in the specific site and context. Students may analyse critically the results obtained and propose measures or improving actions to achieve the city planning goals.

Related competencies :
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CETM1. Knowledge of the design, planning of transport infrastructure and modal terminals, such as highways, railways, ports, airports, railway stations and transport logistics centers exchange.
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Full-or-part-time: 4h
Theory classes: 4h

Project presentation /Presentació del Projecte /Presentación del proyecto

Description:
Students hand out a technical report of the project and present orally the major achievements and lessons learned in a 15-min speech. The project consists of Managing competitive mobility services in a given city to be chosen from 16 available candidate cities. The project is aimed at minimizing the total social cost Z (PV and bus users, operational agency cost, infrastructure cost and external cost) in this city, managing the following policy drivers: the optimal congestion fare for private car users and the optimal length of a new bus network.

Related competencies :
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

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Full-or-part-time: 1h
Theory classes: 1h

GRADING SYSTEM

Individual Exam (T), homework (H) and Project (P). The project may be carried out in groups of 3 people. The final grade is computed as follows: Final grade = {1/3T+1/3P+1/3H}.

EXAMINATION RULES.

The final mark of this subject will be obtained from continuous assessment. Continuous assessment consists of doing individual activities or practices in a group, which are additive and training-oriented. It consists of 1 individual exam in classroom (E1), 1 project assignment (P) in groups of 3 people and 6 activities (homework) in the classroom (A). Students may bring one-page to the exams, where all formulas and important concepts are summarized. Electronic devices (except scientific calculators) are not allowed.

BIBLIOGRAPHY

Basic:
- Daganzo, Carlos. Fundamentals of Transportation and traffic operations. Oxford: Pergamon, 1997. ISBN 0080427855.
- Vuchic, Vukan R. Urban transit : operations, planning, and economics [on line]. New Jersey: Wiley, 2005 [Consultation: 07/10/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=5148926. ISBN 0471632651.
- Vuchic, V.R. Urban Transit: System and Technology [on line]. New Jersey: Wiley, 2007 [Consultation: 27/05/2020]. Available on: https://onlinelibrary.wiley.com/doi/book/10.1002/9780470168066. ISBN 9780471758235.
- Transit Capacity and quality of service manual. Washington: Transportation Research Board, 2003. ISBN 0309087767.

Complementary:
- Ceder, A. ; N.H.M. Wilson. "Bus network design". Transportation Research Part B [on line]. Volume 20, Issue 4, August 1986, Pages 331¿344 [Consultation: 01/08/2014]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/journal/transportation-research-part-b-methodological.- Ceder, Avishal. Transportation and Traffic Theory. Amsterdam: Pergamon, 1999. ISBN 0080434487.