

## Course guide

# 2500022 - GECSITRANS - Transportation Systems

**Last modified:** 01/10/2023

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

**Degree:** BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2020). (Compulsory subject).

**Academic year:** 2023    **ECTS Credits:** 6.0    **Languages:** Catalan, English

### LECTURER

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**Coordinating lecturer:** MIGUEL ANGEL ESTRADA ROMEU

**Others:** HUGO BADIA RODRÍGUEZ, MIGUEL ANGEL ESTRADA ROMEU

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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#### Specific:

14413. Capacity for the construction and conservation of roads, as well as for the dimensioning, the project and the elements that make up the basic road equipment. (Specific technology module: Civil Construction)

14414. Capacity for the construction and conservation of railway lines with knowledge to apply specific technical regulations and differentiating the characteristics of the mobile material. (Specific technology module: Civil Construction)

14422. Capacity for the construction and conservation of roads, as well as for the dimensioning, the project and the elements that make up the basic road equipment. (Specific technology module: Urban Transport and Services)

14423. Capacity for the construction and conservation of railway lines with knowledge to apply specific technical regulations and differentiating the characteristics of the mobile material. (Specific technology module: Urban Transport and Services)

14426. Knowledge of the design and operation of infrastructures for modal exchange, such as ports, airports, railway stations and transport logistics centers. (Specific technology module: Urban Transport and Services)

#### Generical:

14380. Scientific-technical training for the exercise of the profession of Technical Engineer of Public Works and knowledge of the functions of advice, analysis, design, calculation, project, construction, maintenance, conservation and exploitation.

14385. Ability to carry out territorial planning studies and environmental aspects related to infrastructure, in its field.

14386. Capacity for maintenance, conservation and exploitation of infrastructure, in its field.

14390. Identify, formulate and solve engineering problems. Pose and solve construction engineering problems with initiative, decision-making skills and creativity. Develop a systematic and creative method of analysis and problem solving. (Additional school competition).

### TEACHING METHODOLOGY

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The course consists of 2 hours per week of classroom activity (large size group) and 2 hours weekly with half the students (medium size group).

The 2 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 2 hours in the medium size groups 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.

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.

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.

## LEARNING OBJECTIVES OF THE SUBJECT

Knowledge of tools of analysis and evaluation of transport systems. Causal and quantitative functioning of the transport system. Design, operation and exploitation of transport terminals and infrastructures.

- 1 Ability to understand the causal and quantitative operation of the transport system, as well as the behavior of the different agents that compose it (users, operators and Administration / society).
- 2 Knowledge of the design, operation, management and control of terminals and transport infrastructure.
- 3 Knowledge about modal passenger exchange terminals in urban public transport systems.

Basic knowledge of the causal and quantitative functioning of the transport system, as well as the behavior of the different agents (users, operators and Administration / society). Economic impacts of infrastructure and transport services. Knowledge of analysis and assessment tools for transport systems, operational research, traffic theory, operations analysis, estimation and demand forecasting techniques, transport economics, evaluation of alternatives, system modeling and flow allocation. Knowledge of the design, operation, management and control of terminals and transport infrastructures, as well as the management of the resources necessary for their operation and of the patterns of mobility of people and merchandise and their relationship with ICTs. Service focused planning. Intermodal passenger terminals in urban public transport systems, airport terminals (land-side management, air-side management, baggage handling system), port terminals (operation of container terminals, dry and liquid bulk terminals, automobile terminals, ro-ro terminals, etc.), railway terminals and dry ports, highway terminals, logistics centers and merchandise consolidation terminals.

## STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Self study	84,0	56.00
Hours medium group	30,0	20.00
Guided activities	6,0	4.00

**Total learning time:** 150 h

## CONTENTS

### Transport analysis tools

#### Description:

Operations and modeling in transport. Transport chain. Urban mobility.

Problems of airplanes, trains and other vehicles represented by trajectories in space-time diagrams

Space-time diagrams. A vehicle. Many vehicles.

Deterministic theory. Queue discipline. Optimization. Relation between (s-t) and (N-t) diagrams. Applications: traffic accident, train station. Stochastic models.

Correctly apply the appropriate mathematical techniques to transport systems with capacity constraints

#### Specific objectives:

Knowledge of the operations and operation of transport infrastructures

Knowledge of analysis tools for overcoming the distance of a vehicle

**Full-or-part-time:** 38h 24m

Theory classes: 8h

Practical classes: 8h

Self study : 22h 24m

### Operations in transport systems

**Description:**

Traffic theory. Stationary models of traffic flow. Continuity equation. Fundamental variables. Analysis of the fundamental variables at macroscopic and microscopic level. Car following models. Variational theory. Macroscopic Fundamental Diagram in Cities. Control. Detectors. Traffic lights. Networks. Paradoxes.

Traffic theory. Laboratory.

Modal characterization. Line design. Network design in urban areas. Fleet sizing. Operations. Service level.

Urban Mass transport. Problems

**Specific objectives:**

Knowledge of traffic theory for the correct analysis of vehicle operations on the road network

Correctly apply the models of management, evaluation and design of road networks to maximize the efficiency of the service to the user

Knowledge of the design, operation and operation of public transport systems

Use models to define the proper design and operation of public transport networks to maximize the efficiency of the service to the user

**Full-or-part-time:** 43h 12m

Theory classes: 8h

Practical classes: 4h

Laboratory classes: 6h

Self study : 25h 12m

### User behavior and demand models

**Description:**

Data and information. Errors. Sampling. Surveys. Information needs. Elasticities. Demand modeling. UTP modeling. Trip generation / attraction. Trip distribution. Estimation of trip matrices from flow counts. Partial matrices. Discrete choice models. Logit model. Independence from irrelevant alternatives. Hierarchical logit model. Probit model. Calibration for maximum likelihood. Stated and Revealed Preferences. Wardrop Principles. Traffic assignment models.

Introduction to transport system modeling problems

**Specific objectives:**

Knowledge of models for forecasting demand and flow assignment.

**Full-or-part-time:** 38h 24m

Theory classes: 8h

Practical classes: 8h

Self study : 22h 24m

### Transport systems. Modal analysis

**Description:**

Capacity, benefits and level of service. Road transport: costs, road terminals, service stations, tolls.

Subsystems, elements and tasks, optimization of operations, job-scheduling, simulation. Applications: Port, airport and railway terminals.

Air transport network. Costs. Design and management of airport terminals. Rail transport network. Costs. Design and management of railway terminals.

Maritime transport network. Costs. Design and management of port terminals.

**Specific objectives:**

Knowledge of the design and operation of transport terminals as well as the management of the resources necessary for their management

Knowledge of the causal and quantitative operation of the air and rail transport system.

Knowledge of the causal and quantitative operation of maritime and intermodal transport systems.

**Full-or-part-time:** 24h

Theory classes: 6h

Practical classes: 2h

Laboratory classes: 2h

Self study : 14h

## GRADING SYSTEM

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises. It consists of 2 individual exams in the classroom (E1, E2 ), and 3 activities in the classroom or at home (A, homework).

The final mark (FM) for the course by continuous assessment will be determined by the following formula:  $FM = (E1 + E2 + A)/3$ .

Criteria for re-evaluation qualification and eligibility: students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

## BIBLIOGRAPHY

**Basic:**

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- Robusté, F.; Estrada, M.; Campos, M. Sistemas de transporte. Barcelona, 2012.
- Ortúzar, J.D.; Willumsen, L.G. Modelling transport [on line]. 4th ed. Chichester: John Wiley & Sons, 2011 [Consultation: 30/07/2021]. Available on: <https://onlinelibrary.wiley.com/doi/book/10.1002/9781119993308>. ISBN 9780470760390.
- May, A.D. Traffic flow fundamentals. Englewood Cliffs: Prentice-Hall, 1990. ISBN 0139260722.

**Complementary:**



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- Hoel, L.A, N. J.; Garber, N.J.; Sadek, W. Transportation infrastructure engineering: a multi-modal integration. Stamford: Cengage Learning, 2011. ISBN 9780495667896.
- Hillier, F.; Lieberman, G.. Introducción a la investigación de operaciones. 9a ed. México, D.F.: Mc Graw Hill, 2010. ISBN 9786071503084.
- Larson, R.C.; Odoni, A. R. Urban operations research. Belmont, Mass: Dynamic Ideas, 2007. ISBN 9780975914632.
- Rus, G.; Campos, J.; Nombela, G. Economía del transporte. Barcelona: Antoni Bosch editor, 2003. ISBN 849534808X.
- Meyer, M.D. ; Miller, E. Urban transportation planning : a decision-oriented approach. 2nd ed. New York: Mc Graw Hill, 2001. ISBN 0072423323.
- Hall, R.W. (ed.). Handbook of transportation science [on line]. 2nd ed. Boston: Kluwer Academic, 2003 [Consultation: 04/03/2021]. Available on: <https://link.springer.com/book/10.1007/b101877>. ISBN 0306480581.