

Course guide

2500223 - GEA0223 - Sustainable Transport

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 ENVIRONMENTAL ENGINEERING (Syllabus 2020). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: HUGO BADIA RODRÍGUEZ

Others: HUGO BADIA RODRÍGUEZ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

14446. Solve mathematical problems that may arise in engineering by applying knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, optimization, ordinary differential equations.
14447. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.
14448. Manage the basic concepts about the general laws of mechanics and thermodynamics, concept of field and heat transfer, and apply them to solve engineering problems.
14450. Describe the global functioning of the planet: atmosphere, hydrosphere, lithosphere, biosphere, anthroposphere, biogeochemical cycles (C, N, P, S), soil morphology and apply it to problems related to geology, geotechnics, edaphology and climatology.
14453. Describe and apply the techniques of analysis of physical, chemical and biological parameters; Integrate the experimental evidence found in field and / or laboratory data with the theoretical knowledge and interpret its results.
14457. Identify the fundamentals of structure theory, sustainable procedures for construction and dismantling of buildings and civil works; and describe the technology bases of the materials used in construction.
14458. Apply the methodologies of studies and evaluations of environmental impact and, in general, of environmental technologies, sustainability and waste treatment and of the management of international standards of environmental quality. Life cycle analysis, carbon footprint and water footprint and assess natural hazards (river, coastal floods, droughts, fires, soil erosion and landslides).
14459. Describe the components and modes of transport and the impact of their externalities on the environment; identify the principles of environmental management of transport systems and sustainable planning of the territory; and introduce the tools for the management and operation of transport systems.
14461. Analyze, design, simulate and optimize processes and systems with environmental relevance, both natural and artificial, and their resolution techniques, as well as recognize techniques for analysis and evaluation of climate change.
14465. Identify renewable energy generation techniques and energy transition concept.

Generical:

14440. Identify, formulate and solve problems related to environmental engineering.
14441. Apply the functions of consulting, analysis, design, calculation, project, construction, maintenance, conservation and exploitation of any action in the territory in the field of environmental engineering.
14442. To use in any action in the territory proven methods and accredited technologies, in order to achieve the greatest efficiency respect for the environment and the protection of the safety and health of workers and users.

TEACHING METHODOLOGY

The course consists of 4 hours per week of classroom activity.

2-3 hours are devoted to theoretical lectures in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

1-2 hours are 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.

The course is mainly in Spanish, although we will use material in Spanish and English or Catalan.

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

The causal and quantitative functioning of the transportation system is explained, as well as the behavior of the different agents that comprise it. The tools for the analysis and evaluation of transport systems are discussed, such as: traffic theory, operations analysis, demand estimation and prognosis techniques, transport economics, systems modeling, and flow allocation.

The estimation of user costs, operating costs and externalities derived from transport are proposed and discussed: accidents, noise, air pollution, evaluation of transport emissions, climate change, damage to nature and the landscape, the barrier effect, the occupation of space, traffic congestion, ...

Methodologies for evaluating transport projects, evaluating alternatives, cost-benefit analysis and multi-criteria are presented.

The principles of sustainable infrastructure management, public transport and private transport are addressed, with an impact on the environmental management of urban traffic, environmental pricing, car pooling or car sharing, deterrence parking, management policies and fleet renewal. The management of flexible and demand transportation systems is proposed.

Finally, elements of urban logistics and sustainability in the urban distribution of goods are discussed.

1. Know the components and modes of transport, the concepts of capacity and level of service and analyze the transport market, its costs, externalities and environmental impact.
2. Introduce the tools for the management and operation of transport systems, and study the modeling of demand.
3. Understand the principles of environmental management of transport systems and introduce the concepts for sustainable territorial development.

Sustainable transport. Basic concepts and tools to understand transportation management criteria, one of the main sources, will be studied causing air pollution. The principles of environmental management of transport systems and the keys to territorial development will be introduced sustainable.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	15,0	10.00
Hours large group	30,0	20.00
Hours small group	15,0	10.00
Self study	90,0	60.00

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. Tail discipline. Optimization. Relation (st) and (Nt). Applications: traffic accident, train station. Stochastic models
Correctly apply the appropriate mathematical techniques to transport systems with capacity problems

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: 33h 36m

Theory classes: 10h

Practical classes: 4h

Self study : 19h 36m

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. Vehicle tracking models. Variational theory. Macroscopic Fundamental Diagram in Cities.
Control. Detectors. Traffic lights. Nets. Paradoxes.
Traffic theory. Laboratories.
Modal characterization. Line design. Network design in urban areas. Fleet sizing. Operations. Service level.
Urban Collective 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
Correctly apply the models of design and operation of public transport networks to maximize the efficiency of the service to the user

Full-or-part-time: 33h 36m

Theory classes: 8h

Practical classes: 6h

Self study : 19h 36m



User behavior and demand models

Description:

Data and information. Errors. Sampling. Surveys. Information needs. Elasticities. Demand simulation. UTP modeling. Travel generation / attraction. Travel distribution. Estimation of travel matrices from flow counts. Partial matrices. Discrete choice models. Logit model. Independence from irrelevant alternatives. Hierarchical logit model. Probit model. Calibration for maximum likelihood. Declared and Revealed Preferences Wardrop Principles. Traffic allocation models.
Introduction to the problems of modeling of transport systems

Specific objectives:

Knowledge of models for forecasting demand and allocating transport flows

Full-or-part-time: 31h 12m

Theory classes: 8h

Practical classes: 5h

Self study : 18h 12m

Energy and emissions

Description:

Energy and fuels
Vehicles and emissions

Full-or-part-time: 9h 36m

Theory classes: 4h

Self study : 5h 36m

Evaluable activities

Description:

Course project. Introduction
Discussion of the partial results and evaluation of the progress of the project
Course project. Presentations of results

Full-or-part-time: 36h

Laboratory classes: 15h

Self study : 21h

GRADING SYSTEM

The mark of the course is obtained from the ratings of continuous assessment.

Evaluable activities are three: Course project in groups of 3-4 students, and two individual exams in the classroom (partial exam (not eliminate contents) and final exam).

Final grade is obtained with the weighted mean = $0.25 \times \text{Course project} + 0.25 \times \text{Partial exam} + 0.5 \times \text{Final exam}$.

To pass the course the student has to get a grade equal or higher than 5.

Criteria for re-evaluation qualification and eligibility: students that failed the ordinary evaluation and have regularly attended the two exams and have done the course project will have the opportunity of carrying out a re-evaluation exam during the period specified in the academic calendar. Students who have already passed the course or were qualified as non-attending will not be admitted to the re-evaluation exam. The maximum mark for the re-evaluation exam will be five over ten (5) and the final grade will be the maximum between the continuous evaluation and the grade of the re-evaluation exam. The non-attendance of a student to the re-evaluation exam, in the date specified will not grant access to further re-evaluation exams.

Students unable to attend any of the continuous assessment exams due to certifiable force majeure will be ensured extraordinary evaluation periods.

These exams 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.

EXAMINATION RULES.

If one of the activities of the continuous evaluation is not carried out in the scheduled period, it will be considered as a zero score.

BIBLIOGRAPHY

Basic:

- Daganzo, C. Fundamentals of transportation and traffic operations. Oxford: Pergamon, 1997. ISBN 0080427855.
- May, A.D. Traffic flow fundamentals. Englewood Cliffs: Prentice-Hall, 1990. ISBN 0139260722.
- 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.
- Vuchic, V. R. Urban Transit : Systems and Technology. New Jersey: John Wiley, 2007. ISBN 9780471758235.
- Vuchic, V.R. Urban transit: operations, planning, and economics. New Jersey: John Wiley, 2005. ISBN 0471632651.
- Hall, R.W. Handbook of transportation science [on line]. 2nd ed. Boston: Kluwer Academic, 2003 [Consultation: 04/05/2022]. Available on: <https://link.springer.com/book/10.1007/b101877>. ISBN 1402072465.

Complementary:

- Hillier, F.; Lieberman, G.. Introducción a la investigación de operaciones. 9a ed. México, D.F.: Mc Graw Hill, 2010. ISBN 9786071503084.
- Meyer, M.D. ; Miller, E. Urban transportation planning : a decision-oriented approach. 2nd ed. New York: Mc Graw Hill, 2001. ISBN 0072423323.
- Rus, G.; Campos, J.; Nombela, G. Economía del transporte. Barcelona: Antoni Bosch editor, 2003. ISBN 849534808X.