UNICUSANO
ROME

Italian code: ICAR/05 (old) – CEAR-03/B (new) **Credits: 6**
Course: Transportation Engineering and Economics
Main language of instruction: Italian
Other language of instruction: English

Head instructor
Prof. Paolo DELLE SITE - paolo.dellesite@unicusano.it

Objectives

The course deals with the technical and economic aspects of transportation systems. It provides the fundamental theoretical and methodological tools relevant to transportation systems' functional design and planning. Emphasis is given to real-world problems. For a few topics, numerical exercises have been included.

Pre-requisites

- Calculus (mandatory)
- Physics (mandatory)

Course structure

- Transportation systems and their components
- Kinematic and dynamic principles of the motion of ground vehicles
- Road flow theory
- Technological and service characteristics of urban transportation systems
- Organization of freight transportation services
- Mathematical principles of demand and supply economic theory
- Main mathematical models used in transportation planning
- Sustainable mobility policies
- Methodologies for the assessment of interventions on transportation systems

Competencies

A. Knowledge and understanding.

Transportation is a multi-disciplinary area of study. The transportation engineering and economics discipline has been developed by the joint efforts of engineers, economists, planners, geographers, mathematicians, physical scientists and socials scientists.

Key to the discipline is the concept of transportation system. This will be characterized in terms of interactions with mobility demand and the surrounding environment, physical characteristics, service organization, performance and costs. The objectives of the transportation planning activities will be identified. The most frequently used techniques of supply modelling, demand modelling and supply-demand interaction modelling will be shortly reviewed.

The concept of sustainable mobility will be defined with reference to its economic, environmental and social dimensions. The main transport policy principles that are inspired by sustainability with be presented. Finally, the main techniques used in the assessment of the interventions on a transportation system will be reviewed.

B. Applying knowledge and understanding.

The course, through the comprehension of how a transportation system works, aims to develop the ability to identify and assess sustainable solutions to passenger and freight mobility needs.

C. Making judgements.

At the end of the course the student will be able to assess interventions on a transportation system from the points of view of the user, the operator and society.

D. Communication skills.

The student will be endowed with the technical-scientific language needed to interact with other experts in the discipline, and with decision makers in transportation firms and governments.

E. Learning skills.

The course will provide knowledge and methodological tools which might be exploited in subsequent education and professional paths, in the areas of transportation planning, traffic engineering and railway engineering.

Syllabus

Subject 1. Transportation system and its environment.

Transportation and activity systems.

Classification of passenger and freight transportation. Transportation modes. Traffic measures.

Vehicles. Loading units. Infrastructure. Organization. Performance requested by the users.
Externalities: congestion, accidents and energy and environmental impacts.

Subject 2. Motion of ground vehicles.
Dynamics of ground transportation vehicles.
General equation of motion.
Traction curves. Internal combustion engines and electric engines.
Motion resistance forces of road and rail vehicles.
Solution of general equation of motion. Δv method.
Numerical problem: motion diagram of a metro line.

Subject 3. Flow theory.
Classification of ground transportation systems.
Flow models in individually controlled systems.
Capacity of public transportation lines.
Arrivals and service times.
Numerical problem: assessment of a motorway toll station performance.

Subject 4. Urban and metropolitan transportation systems..
Traditional collective transport systems.
Automated vehicles.
Innovative mobility services.

Subject 5. Freight transportation services: actors and organization
Transportation activity and logistics. Distribution networks.
Road, rail, maritime, air and intermodal freight services.
Couriers' organization.
International transportation.

Subject 6. Demand and supply economic theory. Costs.
Introduction to economics.
Partial equilibrium analysis.
Consumption theory.
Firm theory.
Financial equivalence.
Production costs of transportation services.
External transportation costs.

Subject 7. Transportation systems planning and modeling.
Planning activity according to time horizon: strategic, tactic and operational.
Planning activity according to law: Italy example.
Transportation system modeling. Four-step model.
Zoning. Origin-destination matrix.
Supply model: road network and associated graph.
Demand models and assignment models.

Subject 8. Sustainable mobility and the assessment of the interventions on transportation systems.
Sustainable mobility.
Objectives of European transportation policy.
Strategies of sustainable mobility.
Cost-benefit analysis.
Multi-criteria analysis.

Evaluation system and criteria

The examination consists of a written test. This includes:

- 3 open-ended questions (6 marks each for a total of 18 out of 30 marks).
- 3 multiple-choice questions (2 marks each for a total of 6 out of 30 marks).

In addition, two e-tivities, consisting of numerical problems, are compulsory. These need to be sent to the instructor in advance of the examination. Each e-tivity counts 3 marks for a total of 6 out of 30 marks.

Bibliography and resources

1. *Materials to consult*

Notes written by the instructor are available in English.

2. *Recommended bibliography*

Suggested readings are:

- Cascetta E. (2009) Transportation Systems Analysis. Models and Applications. Second Edition. Springer, New York.
- Khisty C.J., Lall B.K. (2002) Transportation Engineering. An Introduction. Third Edition. Prentice-Hall, London.

- Luenberger D.G. (1995) Microeconomic Theory. McGraw-Hill, New York.
- Ortúzar J. de D., Willumsen L.G. (2011) Modelling Transport. Fourth Edition. Wiley, Chichester, UK.
- Profillidis V.A. (2014) Railway Management and Engineering. Ashgate, Farnham.
- Wong J.Y. (2008) Theory of Ground Vehicles. Fourth Edition. John Wiley and Sons, Hoboken N.J.