

Course Unit	Transport Infrastructures		Field of study	Transport Infrastructures	
Master in	Construction Engineering		School	School of Technology and Management	
Academic Year	2022/2023	Year of study	1	Level	2-1
Type	Semestral	Semester	1	ECTS credits	6.0
Code	5024-419-1102-00-22				
Workload (hours)	162	Contact hours	T 30	TP 30	PL -
			TC -	S -	E -
			OT -	O -	

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) Manuel Joaquim da Costa Minhoto

### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Evaluate and choose, either in design or in the work process, the appropriate solutions for paving;
2. Evaluate and choose the construction appropriate technologies to different work situations and design, particularly in the manufacture, commissioning work and quality control of materials of pavement;
3. Define the main loads at which the transportation infrastructures are subject, for structural design of a road pavement;
4. Perform an empirical and mechanistic design of pavement structures and their structural rehabilitation;
5. Approach the study of particular cases of the infrastructures of transport, namely an air infrastructures and a rail infrastructures.

### Prerequisites

Before the course unit the learner is expected to be able to:

1. Know the geotechnical tests for soil foundation, particularly the soil compaction tests;
2. Study adequately a corridor of the transport infrastructures;

### Course contents

Considered loads in transport infrastructures. Geotechnics of roads - earthworks and foundations of the infrastructure of transport. Technologies of construction and rehabilitation of infrastructures of transport. Structural Design of road pavements – empirical and analytical (mechanistic) approach. Models of behavior and design principles. Design Methods. Failure criteria. Structural rehabilitation. Other cases of transport infrastructures: airfields and railways.

### Course contents (extended version)

1. Framework
  - Framework of the transport infrastructures in the context of Civil Engineering - Road Engineering.
  - Introduction to road pavements. Functions. Loads. Behaviour.
  - Pavement types. Constitution of each type of pavement.
2. Study of traffic
  - Characterization and evaluation of traffic.
  - Observation of traffic data. Means of assessment. Traffic Counts. Traffic forecast.
  - Traffic flow (intensity). Conversion into equivalent axle load for pavement design.
  - Conditions of application of traffic loads.
3. The foundation of Pavement
  - Bearing capacity of a pavement subgrade. Bearing capacity based on CBR ratio.
  - Bearing capacity based on plate load test and based on FWD test.
  - Capping layer: materials and characteristics.
  - Soil stabilization: lime, cement, bitumen and mechanical stabilization.
4. Pavement design based on empirical methods.
  - MACOPV method, CBR method, Asphalt Institute method, TRRL method and Spanish method.
5. Paving materials
  - Aggregates. Classification. Characteristics. Grading. Resistance. Shape. Aggregates clean.
  - Binders. Asphalt bitumen. Testing. Viscosity. Cut-back. Bitumen emulsion. Modified bitumen.
  - Pavement layers. Unbound granular subbases and bases and layers with bituminous materials.
  - Concrete cement for pavement layers. Soil-cement layers. Structural cement concrete layers.
6. Bituminous mixes
  - Stability, durability, flexibility, fatigue, adhesion, impermeability and others. Composition.
  - Main types of hot mix asphalt. Formulation of hot mixes asphalt. Marshall method.
  - Cold mixes asphalt.
7. Pavements design
  - General principles. Pavement types of loads. Failures (ultimate) Criteria.
  - Methods for stress and strains calculation.
  - Establishment of the mechanical characteristics of the layers. Application of the failure criteria.
8. Structural rehabilitation of road pavements
  - Deflection evaluation of existing pavements .
  - Deflection analysis: Defining homogeneous sections by the accumulated differences method (AASHTO).
  - Mechanical properties evaluation of pavement layers layers from deflection
  - Analytical and empirical design of pavement overlays.
9. Other cases of transport infrastructures.
  - Airfields infrastructures.
  - Railways infrastructures

### Recommended reading

1. Pavimentos Rodoviários. Pereira, P. A. A. , Picado Santos, L. G. , Branco, F. . Outubro, 2005. Edições Almedina. Coimbra-Portugal;
2. Shell Bitumen Handbook. Read, John and Whiteoak, David. Shell Bitumen. Thomas Telford Publishing. London. 2003;
3. Pereira, Orlando Almeida. 1995. Pavimentos Rodoviários – Volumes I, II, III e IV– LNEC. Lisboa
4. Modern Railway Track. ESVELD, COENRAAD. Ed. MRT-Productions. Zaltbommel, Neetherland, 2001
5. Airport engineering. ASHFORD, N. and WRIGHT, P. H. . John Willy & Sons, 1984.

### Teaching and learning methods

The unit will be taught using a combination of theoretical classes, self guided learning oriented by teacher, through the development of a practical project, and practice classes, where a practical exercises must be resolved. The practical work involves the application of the contents of the theoretical and practical classes to a real case of road design. Also, real examples must be analysed.

**Assessment methods**

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 75%
  - Practical Work - 25%
2. Alternative 2 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 100%

**Language of instruction**

Portuguese, with additional English support for foreign students.

**Electronic validation**

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28-09-2022	05-10-2022	06-10-2022	07-11-2022