INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Transport Infrastructures			Field of study	Transport Infrastructures		
Master in	Construction Engineering			School	School of Technology and Management		
Academic Year	2023/2024	Year of study	1	Level	2-1	ECTS credits	6.0
Type	Semestral	Semester	1	Code	5024-419-1102-00-23		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	30	-	-	-	-	-	-

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) aproach. 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 materils
   - 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.

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Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 80%
   - Practical Work - 20%
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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30-09-2023	04-10-2023	04-10-2023	10-10-2023

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