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.

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

Manuel Joaquim da Costa Minhoto	Flora Cristina Meireles Silva	Manuel Teixeira Brás César	José Carlos Rufino Amaro
30-09-2023	04-10-2023	04-10-2023	10-10-2023