



# UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2023/2024
MASTER'S DEGREE (MSC)	CIVIL ENGINEERING
SUBJECT	ROAD, RAILROAD AND AIRPORT TECHNIQUE
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50353-Ingegneria civile
CODE	13465
SCIENTIFIC SECTOR(S)	ICAR/04
HEAD PROFESSOR(S)	CELAURO CLARA      Professore Associato      Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	141
COURSE ACTIVITY (Hrs)	84
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	<b>CELAURO CLARA</b> Monday    09:00    11:00    Stanza privata del docente Viale delle Scienze al Parco d'Orleans Edificio 8 - DICAM Area infrastrutture viarie

**DOCENTE:** Prof.ssa CLARA CELAURO

<b>PREREQUISITES</b>	Knowledge of Road geometry Knowledge of Geotechnics
<b>LEARNING OUTCOMES</b>	<p>Knowledge and understanding Acquisition of knowledge, methods, criteria and specific advanced instrument in order to be able to:</p> <ul style="list-style-type: none"><li>- identify, at the design phase of road, railways and airports, solutions that are adequate and optimized from the technical, economic and environmental point of view,</li><li>- recognize, during the execution of the works, the conditions ensuring the correct execution with reference to construction equipment, production plants and construction processes;</li><li>- formalize reliable judgments on the execution phases as carried out by the contractor, as well as on their fulfilment of the technical requirements</li></ul> <p>Applying knowledge and understanding Ability to properly applying knowledge, problem solving skills in the field of design, construction and maintenance of roads, railways and airports.</p> <p>Making judgments Ability in integrating knowledge, managing the complexity of the topic as well as to formulate reliable judgements on the quality of infrastructures'projects or works</p> <p>Communication skills Ability to communicate, in a clear and unambiguous way, both in oral and written form, judgments and technical counselling, including the related reasons, in an accessible way to a target audience, both specialist and not.</p> <p>Learning ability Capability of autonomous improving and updating knowledge, for professional purposes, in the field of road railways and airport construction.</p>
<b>ASSESSMENT METHODS</b>	<p>The final examination consists of an oral exam only. The exams consists in questions that allow to ascertain the level of knowledge with regards to the road applied geotechnics, to the materials component of the road mixtures, to the road mixtures'performances as well as to the pavement design methods. The final grade, dependent on the student's replies to the questions during the exam, will be:</p> <p>18/30, Sufficient from 19/30 to 21/30, Satisfactory from 22/30 to 24/30, Fair from 25/30 to 27/30, Good from 28/30 to 29/30, Very Good 30/30 and 30/30 with laude, Excellent</p>
<b>EDUCATIONAL OBJECTIVES</b>	Adequate knowledge of the methodological aspects of the topics of the course and the ability to use that knowledge to interpret and describe engineering problems in the field of design, construction of roads, railways and airports.
<b>TEACHING METHODS</b>	The course takes place in the second half of the 1st year and consists of both lectures and of numerical exercises. Multimedia presentation aided front lessons and exercises will be available in pdf format). During the course, visits to the Laboratory of Road Materials of the Department of Engineering will take place.
<b>SUGGESTED BIBLIOGRAPHY</b>	Santagata F.A (a cura di), Celauro C. et alii. (2016) Strade, Pearson. Edizione Unica. ISBN: 9788891903044

## SYLLABUS

Hrs	Frontal teaching
1	Course introduction: objective, contents and Teaching methods
4	Geotechnics for road applications. Soil and rocks. Excavations problems. Classifications of soil for road constructions
4	Soil Compaction. Proctor study in laboratory. Field compaction: equipment and execution. Compaction control via in situ density measurements.
5	Road subgrades: requirements, construction techniques, theoretical mechanical models, in situ bearing capacity assessment via loading plate tests, CBR tests, resilient modulus tests. Water and frost effect on road subgrades. Drainage. Design water content for subgrade.
4	Soil treatment with lime and or other idraulic binder for road construction. Non conventional materials (demolition and waste material or industrial waste)
3	Earthworks. Equipment for earthworks. Quality control. Planning and managing of earthworks.
2	Road, railways and airport superstructures. Required characteristics and schemes for different destinations. Materials for flexible and rigid pavements

## SYLLABUS

Hrs	Frontal teaching
3	Aggregates: geometrical, mechanical and physico-chemical characteristics and requirements as a function of their final destination. Production and CE marking
6	Bituminous binders: pure and modified with polymers, tars, bituminous emulsions and special binders. Origins, productions, colloidal structure of the bitumen. Rheological behaviour and characterization via conventional and fundamental testing. Bitumen aging. Heukelom e Van der Poel graphs. European and SUPERPAVE specifications
3	Unbound mixtures for subbase, foundation or base layers: natural, from plant crushing, stabilized. Cement treated layers. Bituminous mixtures for wearing course, binder course and base course. Rigid pavements for roads and airports, Mix design.
3	Design of road pavement. Performance of a pavement. Mechanical and functional characteristics. Pavement distress e performance decay. Experimental road. Design Traffic. Physical and mechanical characterization of subgrade and pavement layers. Analytical and empirical design methods.
3	Soil characterization, classification and design application
4	Quality control and management of Earthworks
3	Production, transport, laying and compaction of different mixtures. Quality control and technical specifications.
Hrs	Practice
3	How to write a Technical specification for soils to be used in road construction
3	How to write a Technical specification for unbound mixtures for base and foundations
3	How to write a Technical specification for bituminous mixtures for base, binder and surface layers
3	Design of a flexible pavement: application of both the AASHTO Guide method and the Italian Catalogue (CNR, 92)
4	Mechanical testing of bituminous mixtures: laboratory equipment (Marshall, triaxial cell, creep, wheel tracking)
4	Proctor compaction tests and soil bearing capacity IBI/CBR tests
4	Laboratory tests for mechanical characterization of aggregates
4	Rheological characterization of paving bitumen: pen, TR&B, Fraas and Penetration index calculation
4	Mechanical testing of bituminous mixtures: laboratory equipment (Marshall, triaxial cell, creep, wheel tracking)
4	AASHTO Road Test AASHTO Guide Design method. Italian Catalogue for flexible and rigid pavement design