



UNIVERSITÀ DEGLI STUDI DI PALERMO

SCHOOL	POLYTECHNIC SCHOOL
ACADEMIC YEAR	2016/2017
SECOND CYCLE (7TH LEVEL) COURSE	BUILDING ENGINEERING
SUBJECT	CORROSION AND PROTECTION OF METALLIC MATERIALS FOR BUILDING ENGINEERING
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	20915-Attività formative affini o integrative
CODE	18554
SCIENTIFIC SECTOR(S)	ING-IND/23
HEAD PROFESSOR(S)	SANTAMARIA MONICA Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	<p>SANTAMARIA MONICA</p> <p>Monday 13:00 14:00 Studio personale Edificio 6 secondo piano previa conferma per e-mail</p> <p>Wednesday 12:30 14:00 Studio personale Edificio 6 secondo piano previa conferma per e-mail</p> <p>Friday 12:30 14:00 Studio personale Edificio 6 secondo piano previa conferma per e-mail</p>

DOCENTE: Prof.ssa MONICA SANTAMARIA

TEACHING METHODS	Frontal lectures, Laboratory and Demonstration Sessions, Laboratory Practice Sessions
ASSESSMENT METHODS	Oral exam and discussion on a case study selected by the student. The interview is aimed at determining the student ability to process the knowledge gained by using them to solve problems and the ability to express the teaching content using a technically correct language. The vote is expressed in thirtieths with possible praise, according to the scheme reported at the bottom of the degree program homepage, i.e. "Metodi di valutazione"
LEARNING OUTCOMES	<p>Knowledge and understanding At the end of the course student is expected to have a deep understanding of the mechanism of corrosion processes and on their nature as a function of the environmental physico-chemical conditions. Student will be aware on the synergistic effect of stress and corrosion in materials degradation and failure. He/she is expected to know the corrosion protection methods and strategies and to isolate the critical issues responsible of material degradation. Student will learn about corrosion protection and prevention in the building engineering, necessary for correct design and maintenance of constructions.</p> <p>Applying knowledge and understanding Student is expected to know corrosion mechanism and morphology of the metallic material indifferent environments. Thanks to this fundamental knowledge he/she will be able to understand causes of the corrosion processes with a special focus on the phenomena involving metals and alloys usually employed in the building engineering, being able to select the most appropriate material according to the environmental conditions.</p> <p>Making judgments Starting from knowledge of the theoretical aspects of the corrosion processes as well as from the laboratory experiences the student is expected to be able to match the right material with the environment where the latter is supposed to work, and he/she will regulate the maintenance of aircraft, in order to ensure safe and correct functioning during building and/or constructions life.</p> <p>Communication Student is expected to be able to work autonomously and collaborate with other team members involved in the same project (design and/or maintenance).</p> <p>Learning skills Following a deep understanding of the theoretical aspects and after laboratory experience, student is expected to be able to seek advice from technical regulations, technical manuals, scientific literature updating frequently his/her knowledge.</p>
EDUCATIONAL OBJECTIVES	The aim of the course is to provide basic concepts of corrosion processes and the tools for a correct selection of the materials, of the protection and prevention methods to control and limit the damages and failure in building engineering.
PREREQUISITES	General and Inorganic Chemistry, basic electricity with an emphasis on Ohm's Law
SUGGESTED BIBLIOGRAPHY	Pietro Pedferri, Corrosione e protezione dei materiali metallici. Vol. I e Vol. II, polipress, 2007, Milano Italia. Luca Bertolini, Materiali da Costruzione, Vol. II, seconda edizione, Citta' Studi Edizioni, 2012. Lectures notes and powerpoint presentations.

SYLLABUS

Hrs	Frontal teaching
2	Brief overview on fundamentals of inorganic chemistry and electrochemistry
4	Introduction. General aspects of corrosion processes. Mechanical and physico-chemical properties of materials. Direct and indirect corrosion damages.
6	Wet and dry corrosion. Electrochemical mechanism of corrosion. Corrosion reactions: anodic and cathodic half cell reactions. Faraday's law. Thermodynamics of corrosion. Standard potential, Nerst Equation and Pourbaix diagrams.
6	Kinetic of corrosion. Cathodic and anodic overvoltage. Charge transfer and mass transfer control. Passivation conditions. Evan's diagrams. Influence of metal on corrosion processes.
5	Corrosion attack morphology: generalized corrosion, galvanic coupling, pitting corrosion, crevice corrosion, interference corrosion, selective dissolution, intergranular corrosion, turbulence corrosion, erosion corrosion, impingement corrosion, stress corrosion cracking, fatigue corrosion, hydrogen embrittlement, microbial corrosion. CO ₂ and H ₂ S induced corrosion.

SYLLABUS

Hrs	Frontal teaching
5	Degradation of reinforced concrete structures, Corrosion induced by carbonatation and/or chloride ions., corrosion of pre-stressed concrete. Corrosion phenomena involving metals used for construction directly exposed to natural environment (atmosphere, soil, water). Durability of reinforced concrete and of pre-stressed reinforced concrete structures. Protections methods (coating, surface treatments, cathodic prevention).
3	Protection of structure metallic components: paints, metallic coatings, inhibitors, other surface protections, cathodic protection, material selection.
3	Steel construction. Atmospheric corrosion of carbon steel structure. Protection criteria. Patinable steel. Under ground constructions, offshore constructions. Stainless steel. Stainless steel sensitization. Intergranular corrosion. Non ferrous metallic material for building engineering.
2	Monitoring, evaluation and prevention of corrosion processes: non destructive techniques for corrosion evaluation. Modelling of corrosion processes, Chemical and microstructural analyses for corrosion monitoring and control.
2	Corrosion tests: corrosion rate estimate in laboratory and in real systems (Salt Spray Test, Adhesion test coatings etc).
2	Design and selection of material: data base consulting, smart systems and regulations. Economic evaluation and reliability assessment (Life Cycle Cost, Decision analysis)
Hrs	Practice
2	Pourbaix diagrams from thermodynamics data and their use in corrosion studies.
3	Experimental determination of corrosion potential and corrosion rate. Polarization curve recording in different environments. Corrosion potential measurements and polarization resistance estimate with dc and ac methods. Test on the corrosion resistance of passive films on steel and on non ferrous metallic materials for building engineering.
2	Corrosion protection and prevention: noble materials, passive films, coating, anodic films. Anodizing of Al alloys for building engineering.
2	Inspection techniques on structure and non destructive techniques. Analysis of corrosion damaged materials. Monitoring of on going corrosion processes.
2	Cathodic protection: potential and current density for cathodic protection. Selection of sacrificial anodes.
1	Electrochemical techniques for reinforced concrete repair and restoration.
2	Corrosion products identification by X-ray diffraction and Raman Spectroscopy. Analysis of the attack morphology by scanning electron microscopy.