ENGINEERING FOR SAFETY OF CRITICAL INDUSTRIAL AND CIVIL

(Lecce - Università degli Studi)

Insegnamento RESILENCE OF MATERIALS AND SAFETY OF INFRASTRUCTURES C.I.

GenCod A007270

Docente titolare

Docente responsabile dell'erogazione
PATRIZIA BOCCHETTA

Insegnamento RESILENCE OF MATERIALS AND SAFETY OF

Insegnamento in inglese

Settore disciplinare ING-IND/23

Corso di studi di riferimento
ENGINEERING FOR SAFETY OF CRITICAL INDUSTRIAL AND CIVIL

Tipo corso di studi Laurea Magistrale

Crediti 3.0

Ripartizione oraria Ore Attività frontale: 27.0

Per immatricolati nel 2023/2024

Erogato nel 2024/2025

Anno di corso 2

Lingua

Percorso CIVIL INFRASTRUCTURES

Sede Lecce

Periodo Primo Semestre

Tipo esame Orale

Valutazione

Orario dell'insegnamento
https://easyroom.unisalento.it/Orario

BREVE DESCRIZIONE DEL CORSO

1) Theoretical basis on the electrochemical corrosion processes of metal materials
2) Analysis, prevention and protection of metallic materials
3) Risk of galvanic corrosion for the safety of structures and infrastructures civil and industrial (gas transmission and distribution networks or energy conversion (for example wind turbines).
4) Case studies of structural disasters caused by a lack of knowledge and prevention of electrochemical corrosion of metal structures and/or in reinforced concrete (e.g. Morandi bridge collapse in Genoa)

PREREQUISITI

Conoscenze di matematica, chimica e fisica di base.

OBIETTIVI FORMATIVI	*Knowledge and understanding* The methodological rigor of the discipline will allow the student to develop fundamental skills and understanding skills for the continuation of studies. The theoretical and applied knowledge acquired during the course will enable him to understand the mechanisms of corrosion processes of metal materials in various environments and stresses. *Ability to apply knowledge and understanding* The teaching approach used by the teacher foresees that the frontal theoretical training in the classroom is accompanied by stimulating application examples, which stimulate active participation, a proactive attitude and the ability to work independently. At the end of the course the student will be able to (i) solve relatively simple problems concerning corrosion phenomena in general, (ii) to apply the knowledge acquired on the corrosion processes of materials and infrastructures to real systems through the reading of appropriate diagrams and ISO standards. It will therefore be able to understand the causes of material degradation and propose protection systems appropriate to the structures, as well as assess the risk of corrosion. *Autonomy of judgement* The skills acquired during the course will allow the student to evaluate independently any problems of corrosion of metal materials commonly used in the structural field and to mature expression of autonomous judgements on the impact of different possibilities prevention and protection of structures by coupling scientific and regulatory results to minimize risk situations. *Communication skills* The teaching modalities conceived with theoretical lessons accompanied by exercises in the classroom and in the laboratory require the student to acquire the ability to communicate both strictly theoretical aspects, both those applications and that can express issues related to the topics of the course. The student will acquire skills in the communication of results and design choices and skills of dialogue using appropriate terminology with other insiders. *Learning ability* The transfer of knowledge related to the chemical-physical resistance of materials and structures and the assessment of the associated risks, not common with other courses provided as part of its degree course, will allow the student to manage technical problems thanks to exercises that include long and targeted laboratory activities. It will then be able to self-learn by applying the information acquired in the resolution of problems even not treated in class.
METODI DIDATTICI	LECTURES AND NUMERICAL EXERCISES
MODALITA' D'ESAME	The frequency of the lessons and exercises of the course is highly recommended. The exam modalities include an oral exam at the end of the course. To pass the exam (achieve a minimum score of 18/30), the student must demonstrate that they have acquired sufficient knowledge and understanding on all the topics covered. To achieve the maximum score 30/30 and praise, the student must instead demonstrate that he has acquired, not only the excellent knowledge and understanding of all the topics covered during the course, but also the ability to apply them to engineering design, to make an autonomous judgment on possible alternative solutions, and to communicate the results of its analyses. During the oral exam will be proposed questions, both quantitative and qualitative. The student must demonstrate the ability to process the fundamental knowledge acquired during the course using them to overcome the practical problems proposed, and ability to express themselves with a technically correct language on the contents of the teaching.
ALTRE INFORMAZIONI UTILI	For other informations: Prof. Patrizia Bocchetta patrizia.bocchetta@unisalento.it

PROGRAMMA ESTESO

Lectures

Introduction to the course module. Program. Exam modalities. Introduction to corrosion processes. Theoretical tools behind corrosion systems.

1. General aspects of corrosion. Definition of dry and wet corrosion. Electrochemical corrosion mechanism. Corrosion reactions: anode and cathode processes. Faraday's law. Thermodynamic aspects. Nernst equation.

2. Pourbaix diagrams. Construction and discussion of a generic and specific Pourbaix diagram. Diagram analysis for predicting corrosion processes of a metal structure in a given environment.

3. Kinetics of corrosion systems. Evans diagrams: reading and identification of the operating point. Corrosion rate.

Generalized and localized corrosion. Galvanic corrosion and differential ventilation. Corrosion forms: generalized, galvanic contact, pitting or pitting, crevice corrosion, selective attack, intergranular corrosion, turbulence corrosion, abrasion and friction, stress (stress corrosion cracking)corrosion-fatigue, hydrogen damage, microbiological corrosion.

Methods of protection and prevention: corrosion inhibitors, coatings, cathodic protection, anode protection. TEM monitoring by means of sensors inserted in the concrete: the principles of the method.

Degradation of concrete and reinforcements: corrosion of reinforcements for carbonation and chlorides, corrosion of prestressing reinforcements. Corrosion of metal structures in natural environments (atmosphere, soil, water).

Risk from galvanic corrosion: study of UNI EN 206:2016, classification of exposure conditions and related corrosion risks. Carbonation-induced corrosion, chlorides other than from seawater, chlorides in seawater. Definition of the risk factors in the design phase related to the exposure condition (the environment where the work is located, and therefore the dangerousness, depending on external factors) and vulnerability of the structure (depending on internal factors: materials, design and construction etc.).

Case study: analysis of some structural disasters caused by a lack of knowledge and prevention of electrochemical corrosion of metal and/or reinforced concrete structures (e.g. Morandi bridge collapse in Genoa).

Practical activities

Numerical and experimental activities on the topics of the course.

TESTI DI RIFERIMENTO

Materiale fornito dal docente.

Pietro Pedeferri, Corrosione e protezione dei materiali metallici. Vol. I e Vol. II, polipress, 2007, Milano Italia