# MASTER OF SCIENCE IN CHEMICAL ENGINEERING FOR THE SUSTAINABLE DEVELOPMENT

## MATERIALS TECHNOLOGY AND CORROSION

SSD ING-IND/22, 9 CFU

### Objectives

KNOWLEDGE AND UNDERSTANDING

The course aims to impart the basis for a correct choice of materials for engineering applications, specifically with regards to corrosion mechanisms. The course intends to provide students with the necessary knowledge for the understanding of fundamental processes concerning metal corrosion mechanisms. Moreover, the course intends to provide a basic knowledge on the different forms of corrosion as well as methods to control prevent and protect from corrosion processes.

APPLYING KNOWLEDGE AND UNDERSTANDING

Upon completion of the course, students should be able to recognize the morphology of corrosion and to identify, based on its particular characteristics, the underlying factor that trigger its appearance. In addition, students should be able to understand the operating mechanisms within corrosive processes and to assess potential protection and preventions measure both at planning and maintenance stages.

MAKING JUDGEMENTS

The student will be encouraged to develop a critic approach on the elaboration and comprehension of the subject through questions on every topic which would result not enough clear and by the choice of the text book. Students will be encouraged to autonomously verify the solution plausibility of the proposed problems.

COMMUNICATION SKILLS

The student will learn how to debate the topics of the exam in a clear and effective way. The student will learn to present in a consequential way starting from the requested basic knowledge to develop the subject in a complete manner.

LEARNING SKILLS

The student will develop growing learning skills, by a study methodology that will make the most of the attended classes through an active participation.

### Prerequisites

Basic notions of inorganic and organic chemistry, mathematics and physics.

### Contents

Generalities (12h):
Chemical physical and mechanical properties of materials. Classification of materials: metals, ceramics, polymers and composite. Chemical bonds and material crystal structures. Solidification of metals: polycrystalline materials. Diffusion. Mechanical properties of materials (12h):
stress–strain curves, effect of grain size, hardness, plastic deformation, creep, principle of fracture mechanics, fatigue.
Metals (12h):
Phase diagrams. Ferrous alloys and steels. Iron – carbon phase diagram. Heat treatment of steels. Steels

microstructures. Non-ferrous alloys.
Corrosion and degradation of materials, materials protection (36h):
Electrochemical and thermodynamic principles of corrosion. Anodic and cathodic processes. Potential vs. pH curves. The measurement of the corrosion potential. Nernst equation. Reference electrodes. Corrosion kinetics: activation overpotential and polarization. Corrosion typologies. Evaluation of corrosion resistance. Anodic and chatodic protection. Materials selection for engineering design.

**Teaching Methods**

Lectures presenting the topics of the course and tutorials showing their application to specific problems. Lab tutorials presenting electrochemical corrosion test methods. As of resolution of the Academic Senate of the 26/04/2017, the course will be delivered in English.

**Verification of learning**

Knowledge and abilities concerning materials technology and corrosion are assessed through an exam. The exam consists of a written test administered on paper. The written test consists of n. 3 open-ended questions. The open-ended questions will cover the program of the course, every single exercise/ open-ended question will be valued with a score from 0 to 10 points. The exam involves an evaluation that is expressed as a grade of out of 30 and honors (lode), as duly registered on both a paper and an electronic record-book. An exam is deemed to be passed successfully if the final grade is equal to or higher than 18/30.

**Texts**

William D. Callister Jr., David G. Rethwisch, Materials Science and Engineering: An Introduction, John Wiley & Sons
Mars G.Fontana, Corrosion Engineering. McGraw-Hill
Bibliografia aggiuntiva:
Pietro Pedeferri, Corrosione e protezione dei materiali metallici, Polipress.
Danny A. Jones, Principles and Prevention of Corrosion, Prentice Hall College Div
Walter Nicodemi, Metallurgia: Principi generali - Zanichelli
W.F.Smith, Scienza e Tecnologia dei materiali, McGraw Hill;
Sinnott-Towler, Chemical Engineering Design, Butterworth-Heineman.
Dispense fornite dal Docente scaricabili su http://moodle.unicampus.it