



University of Nicosia, Cyprus

<b>Course Code</b> OGEE-445	<b>Course Title</b> Materials Science & Corrosion Engineering	<b>ECTS Credits</b> 6
<b>Department</b> Engineering	<b>Semester</b> Fall, Spring	<b>Prerequisites</b> CHEM-126
<b>Type of Course</b> Elective	<b>Field</b> Oil & Gas Engineering	<b>Language of Instruction</b> English
<b>Level of Course</b> 1 <sup>st</sup> Cycle	<b>Year of Study</b> 4 <sup>th</sup>	<b>Lecturer(s)</b> Dr Paraskevas Petroyiannis
<b>Mode of Delivery</b> Face-to-face	<b>Work Placement</b> N/A	<b>Co-requisites</b> None

**Objectives of the Course:**

The main objectives of the course are to:

- Introduce students to the atomic structure and interatomic binding in molecules;
- Explain the structure of solids and their defects;
- Provide the fundamentals of the mechanism of diffusion and the mechanical properties of metals;
- Familiarize attendees with the failure modes of different materials;
- Explain the fundamental corrosion mechanisms;
- Acquaint students with corrosion electrochemistry, thermodynamics and corrosion kinetics;
- Detail corrosion induced material failures, marine and high-temperature corrosion;
- Outline the principles of corrosion control, the application of coatings and materials selection;

**Learning Outcomes:**

After completion of the course students are expected to:

- Understand the atomic structure and inter-atomic bonding in materials;
- Be familiar with the fundamental properties of crystalline solids and their imperfections;
- Know the physics of diffusion and the mechanical characteristics of metallic materials;
- Have a thorough appreciation of the failure mechanisms of engineering materials;
- Be acquainted with the principle corrosion mechanisms and their implications;
- Understand the important aspects of corrosion electrochemistry, material thermodynamics and corrosion behavior;
- Recognize corrosion related material failure, aqueous facilitated and temperature governed corrosion;

- Know the fundamentals of corrosion control, the use of protective coatings and material choice.

### Course Contents:

- The discipline of Materials Science and Engineering, electrons in atoms, bonding forces, inter-atomic bonds and molecular structures;
- Crystal lattices, polycrystalline materials, anisotropy, closed-packed structures;
- Point defects in solids, dislocations, bulk or volume defects, microscopic examination techniques;
- Physics of diffusion mechanisms, steady and unsteady diffusion;
- Mechanical properties of materials including elastic & plastic deformation and design & safety considerations;
- Failure modes of materials: fracture, fatigue and creep;
- The significance of corrosion, basic concepts in corrosion such as anodic & cathodic reactions, corrosion cells, Nernst equation, influence of pH and acidity;
- Electrochemical reactions, anodic and cathodic processes, surface area effect, concentration polarization, etc;
- Galvanic corrosion, intergranular corrosion, crevice corrosion, pitting corrosion, erosion and biological corrosion, corrosion fatigue, hydrogen damage and liquid metal attack;
- Selection and application of coatings, cathodic protection, corrosion inhibitors, materials selection;
- Heat affected zones, design for corrosion in the oil and gas, pipeline and marine industries.

### Learning Activities and Teaching Methods:

Lectures, Discussion

### Assessment Methods:

Homework, mid-term exam, final exam, exercises.

### Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Callister D.W. Jr. & Rethwisch G.D.	Materials Science and Engineering— An Introduction, 9 <sup>th</sup> ed.	John Wiley & Sons	2014	978-1-118-32457-8
Roberge R.P.	Corrosion Engineering: Principles and Practice	McGraw Hill	2008	0-07-148243-1

### Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Javaherdashti R., Nwaoha C. & Tan H.	Corrosion and Materials in the Oil and Gas Industries	CRC Press	2013	978-1-4665-5625-6

Mitchell S.B.	An Introduction to Materials Engineering and Science	John Wiley & Sons	2004	109-8-7654-321
Ahmad Z.	Principles of Corrosion Engineering and Corrosion Control	Elsevier-BH	2006	978-0-7506-5924-6