

Course Unit	Welding and Coating Processes		Field of study	Mechanical Constructions	
Master in	Industrial Engineering - Mechanical Engineering		School	School of Technology and Management	
Academic Year	2020/2021	Year of study	1	Level	2-1
Type	Semestral	Semester	2	Code	9572-356-1205-00-20
Workload (hours)	162	Contact hours	T -	TP 60	PL -
			TC -	S -	E -
			OT -	O -	

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) João Eduardo Pinto Castro Ribeiro

#### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Know the processes of welding technology and understand the physical phenomena that are associated.
2. Create sensitivity to the degradation of metals and to know the technologies for their protection
3. Knowing how to use the knowledge obtained in the implementation of joint technologies.
4. Set operations and welding parameters in order to properly use the equipment in the production of mechanical pieces.
5. Perform quality control of mechanical pieces obtained by welding.
6. Knowing the forms of metal corrosion. Define and implement methods to protect against the most corrosion forms.

#### Prerequisites

Before the course unit the learner is expected to be able to:

1. Apply basic knowledge of chemistry and materials science.
2. Apply basic knowledge of metallography.
3. Apply a basic knowledge of heat transfer and thermodynamics.
4. Have a good knowledge of the English language: spoken and written.

#### Course contents

Properties and classification of welding processes. Types of welding: acetylene welding, shielded arc welding (SMAW), TIG, MIG / MAG, submerged arc welding and spot welding (resistance welding). Structural adhesives. Atmospheric corrosion and electrochemical corrosion. Anti-corrosion protection: electrolytic coatings, sacrificial anodes, PVD, CVD and paints.

#### Course contents (extended version)

1. Properties and classification of welding processes.
2. Types of welding:
  - Acetylene welding.
  - Shielded arc welding (SMAW).
  - TIG.
  - MIG / MAG.
  - Submerged arc welding.
  - Spot welding (resistance welding).
3. Concept of weldability and steel weldability and thermal phenomena associated with welding fusion.
4. Cracking in the welding of steels.
5. Determination of preheat temperature.
6. Deformations in welding. Problems associated with residual stresses.
7. Preparation of joints to welding. Heat treatment after welding.
8. Welding defects.
9. Approval of welding procedures.
10. Structural adhesives.
11. Atmospheric corrosion and electrochemical corrosion.
  - Concept of electrode and the electrode potential.
  - Electrodes of reference. Nernst equation.
  - Forms of corrosion, oxidation-reduction reactions.
12. Diagrams of Pourbix: regions of immunity.
  - Corrosion and passivation. Inhibitors of corrosion, their classification and action mechanisms.
  - Speed of corrosion: straight from Tafel.
13. Treatment of passivation, conversion coatings and temporary:
  - Phosphatizing.
  - Black oxidation.
  - Temporary coatings.
14. Anodizing: procedures for the mechanical polishing, electrolytic polishing and etching acid.
15. Electroplating: theories of electroplating.
  - Technology and process control, anode characteristics.
  - systems of surface preparation, electroplating, deposits properties and their applications.
16. Electrolytic coatings, sacrificial anodes, PVD, CVD and paints.

#### Recommended reading

1. Ribeiro, J. , Processos de Ligação e Revestimentos, ESTIG-IPB, 2010.
2. Messler, R. , Principles of welding: processes, physics, chemistry, and metallurgy; New York: John Wiley, cop. 1999.
3. Lancaster, J. , Metallurgy of welding; 6th ed; Cambridge : Abington Publishing, cop. 1999.
4. Fontana, Mars G. , Corrosion Engineering, McGraw-Hill.
5. ASM handbook: Corrosion, Editorial Assistance, 1990.

#### Teaching and learning methods

Theoretical-practices classes are used with an expository component of the theoretical subjects and a practical component of problems resolution and practical cases analysis. It is also used the interrogative method, questioning the students systematically about the most important elements of the course. In non-presence environment is proposed the resolution of problems and accomplishment works.

**Assessment methods**

1. Alternative 1 - (Regular, Student Worker) (Final)
  - Practical Work - 50%
  - Intermediate Written Test - 20%
  - Development Topics - 30%
2. Alternative 2 - (Regular, Student Worker) (Supplementary, Special)
  - Final Written Exam - 100%

**Language of instruction**

Portuguese, with additional English support for foreign students.

**Electronic validation**

João Eduardo Pinto Castro Ribeiro	João da Rocha e Silva	José Alexandre de Carvalho Gonçalves	Paulo Alexandre Vara Alves
23-02-2021	25-02-2021	02-03-2021	06-03-2021