Aerospace Materials II

Academic Year: (2019 / 2020) **Review date: 16-05-2020**

Department assigned to the subject: Materials Science and Engineering and Chemical Engineering Department

Coordinating teacher: CIFUENTES CUELLAR, SANDRA CAROLINA

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Aerospace Materials I

OBJECTIVES

To understand the structure, composition, processing, properties and performance of different families of metallic materials used in aerospace and the relationship among them.
To be able to select metallic materials for applications in different aerospace engineering fields.
To know the more adequate standardized tests to evaluate properties and performance of metallic materials, and to analyze the results.
Regarding general capabilities or skills, during the year, students will acquire the following abilities:
- Ability to solve complex problems.
- Ability to look for, to understand and to differentiate the relevant information to be able to take a decision.
- Ability to use multi-disciplinary knowledge to solve a problem.
- Ability to work in groups and distribute work to face up to complex problems.

DESCRIPTION OF CONTENTS: PROGRAMME

- Solidification of Metals. Generation of the Microstructure. Metal Casting Processes. Cast Structures Defects in Castings.
- Metal forming processes. Work hardening. Recovery, Recrystallization and Grain Growth. Effect of metal forming processes on properties and microstructure. Formability.
-Phase Diagrams. Invariant Reactions. Influence of alloying elements. Equilibrium phase transformation.
- Non-equilibrium phase transformations. TTT diagrams: ITT and CCT. Heat Treatments: Quenching, Tempering, Annealing, Normalizing. Hardenability
-Introduction to Fracture. Types of Fracture. Fracture modes. Fracture mechanics. Stress concentration. Griffiths theory. Stress intensity factor. Fracture toughness and Impact test. Brittle Ductile transition.
- Introduction to Fatigue. High cycle fatigue. Low cycle fatigue. Effect of variable cycles. Fatigue crack growth.Structural features of fatigue. Designing against fatigue failure
-Creep. Creep curve. Effect of stress and temperature on creep. Creep stages. Creep design and life prediction. Developing creep-resistant materials.
- Corrosion. Basic electrochemical corrosion. Types of corrosion. Corrosion control and prevention. High temperature corrosion.
- Friction. Wear. Friction and wear tests. Lubricants. Wear and friction in metal-working processes. Materials selection for tribological system.
- Designation of Aluminium Alloys. Heat treatable aluminium alloys. Non heat treatable aluminium alloy. Applications of Al alloys in aerospace. Mg alloys.
- Designation of Titanium alloys. Properties of Ti alloys. Heat Treatments for Ti alloys. Applications.
- Ultra high strength steels. PH stainless steels. Maraging Steels.
- Ni-based alloys and superalloys. Properties and applications.
- Intermetallics in aerospace. Properties and applications.
- Main surface treatments: Galvanizing; Electrodepostion; Organic Coatings; CVD; PVD: Thermal Spraying. Thermochemical Treatments. Thermal Barrier Coatings.
- Introduction to joining processes. Welding. Welding processes for aerospace applications.
- Common NDT method. Visual Inspection. Liquid Penetrants. Magnetic Particle. Eddy Current. Radiographic. Ultrasonic Acoustic Emissions. Method comparison.

LEARNING ACTIVITIES AND METHODOLOGY

-The course will consist of Master Classes where the theory of the topics will be presented and Tutorial Classes where applications and examples will be emphasized and problems exercises will be solved
- There will be tutorial sessions for the students
- There will be 6 hours of practical laboratory work of compulsory assistance. The laboratory sessions will result in the acquisition of practical abilities related to the content of the course
- All the teaching material (lecture notes, handouts, exercises and problems, laboratory manual and additional material) will be distributed to the students through aula global

ASSESSMENT SYSTEM

Continuous evaluation will consist of two parts:
(i)exercises and tests to be solved in groups or individually, during classes, or other activities (at least 3 activities) that will count 30% of the total mark.
(ii)laboratory practices, that will be assessed with a questionnaire that will be handed in at the end of each laboratory session, and that will count 10% of the total mark.
The assistance to the laboratory sessions is MANDATORY. The entrance to the laboratory is enabled once the student has watched the general security video and the specific video for materials lab and answered both tests correctly. THE STUDENT CAN NOT ENTER THE LABORATORY IF HE/SHE HAS NOT ANSWERED THE TESTS. THE NON-ASSISTANCE TO THE LABORATORY WITHOUT JUSTIFIED CAUSE IMPLIES SUSPENDING THE CONTINUOUS EVALUATION.

Percentage of continuous evaluation assessment (exercises, tests, laboratory): 40
-The final examination will count for 60% of the total mark of the course. Help sessions and tutorial classes will be held prior to the final exam.
Percentage of end-of-term-examination: 60
Minimum mark for end-of-term-examination: 4
In order to pass, the final mark must be at least 5.

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- Adrian P. Mouritz Introduction to aerospace materials , Woodhead publishing, 2012
- CALLISTER WD Materials science and engineering: an introduction, John Wiley & Sons, 2003
- Campbell, F.C. Manufacturing technology for aerospace structural materials , Elsevier, 2006
- Donachie, Matthew J Superalloys : a technical guide, American Society Metals, 2002
- Kalpakjian, S.Addison Manufacturing Engineering and Technology, Wesley Publishing, 1992
- Polmear, I.J Light alloys : from traditional alloys to nanocrystals , Elsevier/Butterworth-Heinemann, 2006