Universidad Carlos III de Madrid

Department of Materials Science and Engineering and Chemical Engineering

BACHELOR IN AEROSPACE ENGINEERING	CREDITS: 6 ECTS	COURSE: 2019/2020
LECTURE COURSE : AEROSPACE MATERIALS II (251 - 15338)	YEAR: 2	SEMESTER: 2nd

Session	PART	Topic	Master Class /Tutorial Class	Professor.	TITLE	DESCRIPTION
1	**PRESENTATION OF LECTURE COURSE**	1	**MC**	**SM**	**Introduction to Aerospace Materials II**	Introduction to the course. Course structure and Evaluation. Classification of engineering metallic materials
2	**1. METALLIC MATERIALS**	2	**TC**	**SC**	**Solidification of Metals**	- Solidification of Metals. Generation of the Microstructure
3	**1. METALLIC MATERIALS**	2	**MC**	**SM**	**Metal Casting Processes**	Metal Casting Processes. Cast Structures Defects in Castings.
4	**1. METALLIC MATERIALS**	3	**TC**	**SC**	**Metal Forming Fundamentals**	Work hardening. Recovery, Recrystallization and Grain Growth..
5	**1. METALLIC MATERIALS**	3	**MC**	**SM**	**Metal Forming Processes**	Metal forming processes. Effect of metal forming processes on properties and microstructure
6	**1. METALLIC MATERIALS**	4	**TC**	**SC**	**Heat Treatments I**	- TTT diagrams: ITT and CCT. Heat Treatments: Quenching, Tempering, Annealing, Normalizing. Hardenability
7	**1. METALLIC MATERIALS**	4	**MC**	**SM**	**Heat Treatments II**	- TTT diagrams: ITT and CCT. Heat Treatments. **Problems.**
8	**1. METALLIC MATERIALS.**	4	**TC**	**SC**	**Heat Treatments II**	**Problems**
9	**2. BEHAVIOUR IN SERVICE CONDITIONS.**	5	**MC**	**SM**	**Mechanisms of deformation and fracture I : Fracture**	-Introduction to Fracture. Types of Fracture. Fracture modes. Fracture mechanics. Stress concentration. Griffith's theory. Stress intensity factor. **Problems**
10	**2. BEHAVIOUR IN SERVICE CONDITIONS.**	5	**TC**	**SC**	**Mechanisms of deformation and fracture I : Fracture**	-Fracture. Fracture toughness and Impact test Brittle Ductile transition. **Problems.**
11	**2. BEHAVIOUR IN SERVICE CONDITIONS.**	6	**MC**	**SM**	**Mechanisms of deformation and fracture II: Fatigue**	- Introduction to Fatigue. High cycle fatigue. Low cycle fatigue Effect of variable cycles. Fatigue crack growth
12	**2. BEHAVIOUR IN SERVICE CONDITIONS.**	6	**TC**	**SC**	**Mechanisms of deformation and fracture II: Fatigue**	-Fatigue. Structural features of fatigue Designing against fatigue failure. **Problems.**
13	**2. BEHAVIOUR IN SERVICE CONDITIONS.**	7	**MC**	**SM**	**Thermomechanical behaviour : Creep**	-Creep. Creep curve. Effect of stress and temperature on creep. Creep stages. **Problems**.
14	**2. BEHAVIOUR IN SERVICE CONDITIONS.**	7	**TC**	**SC**	**Thermomechanical behaviour : Creep**	-Creep design and life prediction. Developing creep-resistant materials. **Problems**.
15	**2. BEHAVIOUR IN SERVICE CONDITIONS.**	8	**MC**	**SM**	**Corrosion and Wear: Corrosion**	Corrosion. Basic electrochemical corrosion. Types of corrosion. Corrosion control and prevention. High temperature corrosion

16	**2. BEHAVIOUR IN SERVICE CONDITIONS.**	8	**TC**	**SC**	**Corrosion and Wear: Wear**	Friction. Wear. Friction and wear tests. Lubricants. Wear and friction in metal-working processes. Materials selection for tribological system. (Voluntary Presentation)
17	**3. APPLICATIONS**	9	**MC**	**SM**	**Ti alloys I**	Introduction to Ti. Fundamentals of Ti and Ti alloys. Classification of Ti alloys. Production processes and manufacturing
18	**3. APPLICATIONS**	9	**TC**	**SC**	**Ti alloys II**	Phase transformations in Ti alloys. Characteristics of Ti alloys. Heat Treatments for Ti alloys. Applications of Ti in aerospace (Voluntary Presentation)
19	**3. APPLICATIONS**	10	**MC**	**SM**	**Al- alloys I**	History of Aluminum Applications Aluminium Obtaining. Designation of Aluminium Alloys Hardening mechanisms.
20	**3. APPLICATIONS**	10	**TC**	**SC**	**Al- alloys II**	Non Heat treatable Wrought Aluminium Alloys Heat treatable Wrought Aluminium Alloys. Cast Aluminium alloys. Applications in aerospace. Aluminium Processing and Joining (Voluntary Presentation)
21	**2. BEHAVIOUR IN SERVICE CONDITIONS.**	11	**TC**	**SC**	**Joining Processes**	Introduction to joining processes. Welding. Welding processes for aerospace applications. (Voluntary Presentation)
22	**3. APPLICATIONS**	12	**MC**	**SM**	**Special Steels**	Special ultra high strength steels , PH stainless steels. Maraging Steels.
23	**3. APPLICATIONS**	13	**TC**	**SC**	**Surface Treatments**	Main surface treatments: Galvanizing; Electrodepostion; Organic Coatings; CVD; PVD: Thermal Spraying. Thermochemical Treatments. Thermal Barrier Coatings (Voluntary Presentation)
24	**3. APPLICATIONS**	14	**MC**	**SM**	**Alloys for high Temperature applications: Superalloys**	Superalloys: Microstructure, strengthening Mechanisms. Properties
25	**3. APPLICATIONS**	15	**TC**	**SC**	**Non-destructive Testing**	Common NDT method. Visual Inspection. Liquid Penetrants Magnetic Particle. Eddy Current. Radiographic. Ultrasonic Acoustic Emissions. Non-destructive testing. Method comparison. (Voluntary Presentation)
26	**3. APPLICATIONS**	14	**MC**	**SM**	**Alloys for high Temperature applications: Intermetallics**	Intermetallics: Nickel Aluminides. Titanium aluminides. Manufacturing properties and applications. Thermal Barrier coatings
27			**MC**	**SC**	**REVISION**	