

[MHH108] SOLIDIFICATION PROCESSING OF METALS

GENERAL INFORMATION

Studies	UNIVERSITY MASTER IN INDUSTRIAL ENGINEERING	Subject	MANUFACTURING PROCESS ENGINEERING
Semester	2	Course	1
Character	OPTIONAL	Mention / Field of specialisation	
Plan	2017	Modality	Adapted Face-to-face
Credits	5	Hours/week	3.33
		Language	ENGLISH
		Total hours	60 class hours + 65 non-class hours = 125 total hours

PROFESSORS

HURTADO HURTADO, JOSE IGNACIO
DOK3-BERNAL RODRIGUEZ, DANIEL
PLATA REDONDO, GORKA

REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
(No specific previous subjects required)	Fundamentals of materials science

SKILLS

VERIFICA SKILLS

SPECIFIC

MHC02 - To be able to plan, calculate and design integrated manufacturing systems

MHC04 - To be able to analyse and design chemical processes

CROSS

MHC47 - To select one measure or idea out of several and implement them in response to the needs or circumstances emerging in the work process

BASIC

M_CB6 - To have and understand knowledge which provides a base or opportunity to be original in the development and/or application of ideas, often in an investigation context

M_CB7 - To know how to apply the acquired knowledge and competencies and the ability to solve problems in new or unfamiliar contexts within wider (or multidisciplinary) environments related to their field of study

M_CB9 - To share knowledge, conclusions and their rationale with specialised and lay audiences in a clear, unambiguous manner

ENAAE LEARNING RESULTS

	ECTS
ENA124 - Knowledge and comprehension: Deep knowledge and comprehension of the engineering disciplines of their speciality, at the level necessary to acquire the rest of the competencies of the degree.	0,5
ENA128 - Analysis in engineering: Ability to conceive new products, processes, and systems.	0,6
ENA133 - Research and innovation: Ability to identify, find and obtain the required data.	0,5
ENA134 - Research and innovation: Ability to carry out bibliographic searches and consult and use databases and other information sources with discretion, in order to carry out simulations with the aim of conducting research on complex topics of their speciality.	0,5
ENA136 - Research and innovation: High-level capacity and ability to project and carry out experimental investigations, interpret data with criteria, and draw conclusions.	0,3
ENA137 - Research and innovation: Ability to investigate the application of the most advanced technologies in their speciality.	0,6
ENA139 - Practical application of engineering: Practical skills, such as the use of computer tools to solve complex problems, carry out complex engineering projects, and design and guide complex investigations.	0,6
ENA140 - Practical application of engineering: Complete knowledge of application of materials, equipment and tools, engineering technology and processes, and their limitations.	0,8
ENA146 - Communication and Teamwork: Ability to employ different methods to communicate their conclusions, clearly and unambiguously, and the knowledge and logical foundations that support them, to audiences specialised and not specialised in the issue, in domestic and international contexts.	0,6

Total: 5

LEARNING RESULTS

RA170 Knows the fundamentals of solidification science, melt treatment and phase diagrams.

LEARNING ACTIVITIES

	CH	NCH	TH
Development, writing and presentation of memorandums, reports, audiovisual material, etc. Relating to projects/POPBLs carried out individually or in teams		10 h.	10 h.
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	22 h.	14 h.	36 h.

Individual and team exercises	6 h.	6 h.	12 h.
Individual and/or team computer simulation practice	4 h.		4 h.
EVALUATION SYSTEM	W	MAKE-UP MECHANISMS	
Individual written and oral tests to assess technical skills of the subject	100%	Individual written and oral tests to assess technical skills of the subject	
Comments: open-book All activities (control points, individual and group assignments, etc...) must have a minimum mark (5 minimum) and there will be an opportunity to retake every activity. In case of retake of the control point, the final mark will be the mark of the retake.		Comments: 25% first test + 75% second test qualification	
CH - Class hours: 32 h.			
NCH - Non-class hours: 30 h.			
TH - Total hours: 62 h.			

RA171 Knows the technological fundamentals of casting processes and optimises them using simulation tools.			
LEARNING ACTIVITIES	CH	NCH	TH
Development, writing and presentation of memorandums, reports, audiovisual material, etc. Relating to projects/POPBLs carried out individually or in teams		12 h.	12 h.
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	12 h.	10 h.	22 h.
Individual and team exercises	8 h.	5 h.	13 h.
Individual and/or team computer simulation practice	8 h.	8 h.	16 h.
EVALUATION SYSTEM	W	MAKE-UP MECHANISMS	
Individual written and oral tests to assess technical skills of the subject	100%	Individual written and oral tests to assess technical skills of the subject	
Comments: Flow3D - Individual work All activities (control points, individual and group assignments, etc...) must have a minimum mark (5 minimum) and there will be an opportunity to retake every activity. In case of retake of the control point, the final mark will be the mark of the retake. Failed assignments, practices, etc... must be retaken and will be graded with a maximum mark of 5.		Comments: 25% first test + 75% second test qualification	
CH - Class hours: 28 h.			
NCH - Non-class hours: 35 h.			
TH - Total hours: 63 h.			

CONTENTS

1. Fluid dynamics
 - 1.1. Filling system design
 - 1.2. Fluidity
 - 1.3. Surface tension
4. Solidification shrinkage
 - 4.1. General behaviour
 - 4.2. Solidification shrinkage
 - 4.3. Feeding: 6 rules
 - 4.4. Feeding: 5 mechanisms
 - 4.5. Nucleation, grow and final shape of pores
5. Thermodynamics and phase diagrams
 - 5.1. Gibbs energy concept applied to solidification processes

- 5.2. Activity and chemical potential concepts
- 5.3. Ordered phases and heterogeneous systems
- 5.4. Phase diagrams from the point of view of free energy
- 5.5. Interphases and solidification structures
- 5.6. Multicomponent systems
- 6. Solidification
 - 6.1. Nucleation in pure metals
 - 6.2. Grow in pure metals
 - 6.3. Solidification of alloys
 - 6.4. Applications of solidification theories

LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources	Bibliography
Subject notes	Fredriksson, H. and Akerlind, U. Materials processing during casting. Chichester: Wiley, 2006. ISBN: 0-470-01514-4
Labs	Porter, D.A. and Easterling K. Phase Transformations in Metals and Alloys. Gran Bretaña: Van Nostrand Reinhol, 1981. ISBN: 0-442-30439-0
Moodle Platform	Campbell, J. Castings. Butterworth-Heinemann, Oxford, 2002. ISBN: 0-7506-1696-2
Specific Master Software	
Video projections	