

[MHFF01] SOLIDIFICATION AND CASTING TECHNOLOGY

GENERAL INFORMATION

Studies	UNIVERSITY MASTER IN INDUSTRIAL ENGINEERING	Subject	MANUFACTURING PROCESS ENGINEERING
Semester	2	Course	1
Character	OPTIONAL	Mention / Field of specialisation	???
Plan	2010	Language	CASTELLANO/ENGLISH
Credits	4,5	Hours/week	3.64
		Total hours	65.5 class hours + 47 non-class hours = 112.5 total hours

PROFESSORS

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HERRERO DORCA, NURIA

REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
(No specific previous subjects required)	Materials science Thermodynamics Thermal and fluid engineering

SKILLS

VERIFICA SKILLS

SPECIFIC

- MHC02** - To be able to plan, calculate and design integrated manufacturing systems
- MHC03** - To be able to design and test machines
- MHC04** - To be able to analyse and design chemical processes
- MHC08** - To be able to plan and design automated manufacturing systems and advanced process control systems
- MHC12** - To have knowledge of financial and cost accounting
- MHC16** - To be able to manage Research, Development, and technological Innovation.

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_CB10** - To have learning skills and the capacity for self-guided or independent subsequent learning.
- 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_CB8** - To be able to integrate different types of knowledge and make complex judgements based on information that, in spite of being partial or limited, includes ideas on the social and ethical responsibilities associated with the application of knowledge
- M_CB9** - To share knowledge, conclusions and their rationale with specialised and lay audiences in a clear, unambiguous manner

ENAE 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.	0,45
ENA128 - Analysis in engineering: Ability to conceive new products, processes, and systems.	0,54
ENA133 - Research and innovation: Ability to identify, find and obtain the required data.	0,45
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.	0,45
ENA136 - Research and innovation: High-level capacity and ability to project and carry out experimental investigations, interpret data with criteria, and draw conclusions.	0,27
ENA137 - Research and innovation: Ability to investigate the application of the most advanced technologies in their speciality.	0,54
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.	0,54
ENA140 - Practical application of engineering: Complete knowledge of application of materials, equipment and tools, engineering technology and processes, and their limitations.	0,72
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.	0,54

Total: 4,5

LEARNING RESULTS

RMH160 Meet the science fundamentals of the solidification processes: nucleation and growth of grains, thermodynamics and phase diagrams, heat transfer, Gibbs free energy,...

LEARNING ACTIVITIES		CH	NCH	TH
Classroom presentations of relevant concepts and procedures in participatory environments.		11 h.	10 h.	21 h.
Individual study and work, tests and evaluations.		3 h.		3 h.
Workshop and/or lab practice.		4 h.		4 h.
Individual and/or group project development, report writing and presentations.		12,5 h.	12 h.	24,5 h.
Development, writing and presentation of group projects and/or POPBL.		6 h.		6 h.
EVALUATION SYSTEM	W	MAKE-UP MECHANISMS		
Test	75%	Retake of the test		
Presentation of the group work (Fundaments of solidification processes)	20%	Comments:		
Lab practices	5%			
<p>Comments: All training activities (check points, individual and team works,&#8230;) must have a minimum of a 5 and a retake opportunity. In case of taking a retake (RE) of the check point (PC) the final mark (N) will be calculated as follows: $N=0,25*PC+075*RE$ The failed tasks, training&#8230; must be retaken and they will be valued with a maximum of a 5.</p>				
<p>CH - Class hours: 36,5 h. NCH - Non-class hours: 22 h. TH - Total hours: 58,5 h.</p>				

RMH161 Meet the technological foundations of casting processes: filling system design and feeding of parts, solidification shrinkage, mold-metal reactions,...				
LEARNING ACTIVITIES		CH	NCH	TH
Classroom presentations of relevant concepts and procedures in participatory environments.		10 h.	9 h.	19 h.
Individual study and work, tests and evaluations.		2 h.		2 h.
Individual and/or group project development, report writing and presentations.		14 h.	13 h.	27 h.
Development, writing and presentation of group projects and/or POPBL.		3 h.	3 h.	6 h.
EVALUATION SYSTEM	W	MAKE-UP MECHANISMS		
Test	75%	Retake of the test		
Individual or group exercises (Fundaments of solidification processes)	25%	Comments:		
<p>Comments: All training activities (check points, individual and team works,&#8230;) must have a minimum of a 5 and a retake opportunity. In case of taking a retake (RE) of the check point (PC) the final mark (N) will be calculated as follows: $N=0,25*PC+075*RE$ The failed tasks, training&#8230; must be retaken and they will be valued with a maximum of a 5.</p>				
<p>CH - Class hours: 29 h. NCH - Non-class hours: 25 h. TH - Total hours: 54 h.</p>				

CONTENTS

1. Fluid dynamics
 - 1.1. Filling system design
 - 1.2. Fluidity
 - 1.3. Surface tension
2. Moulds dynamic
 - 2.1. Shape and dimension changes in the mould
 - 2.2. Gaseous pressure in mould and cores
 - 2.3. Transformation zones
 - 2.4. Metal-mould reactions
3. Solidification dynamics
 - 3.1. Heat transfer
 - 3.2. Phase diagrams from the point of view of AT experiment
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
Handouts of the subject Laboratories Talks given by external professionals	Materials Processing during Casting; H. Fredriksson and u. Akerlind, Jon Willey & sons Ltd. England, 2006; 434 páginas; ISBN: 0-470-01514-4; Inglés Solidification processing; Merton C. Flemings; McGraw Hill; New York; 1974; 364 páginas; ISBN: 0-07-021283-X; Inglés Phase Transformations in Metals and Alloys; d.A. Porter and K. Easterling, Gran Bretaña, 1981; Van Nostrand Reinhold; 466 páginas; ISBN: 0-442-30439-0; Inglés Castings; John Campbell, Butterworth-Heinemann, Oxford, 2002; 288 páginas; ISBN: 0-7506-1696-2; Inglés.