[MHH109] METAL SOLIDIFICATION PROCESSES

GENERAL INFORMATION

Studies	UNIVERSITY MASTER IN INDUSTRIAL ENGINEERING			**Subject**	MANUFACTURING PROCESS ENGINEERING
Semester	1	**Course**	2	**Mention / Field of specialisation**	
Character	OPTIONAL				
Plan	2017	**Modality**	Adapted Face-to-face	**Language**	ENGLISH
Credits	5	**Hours/week**	3	**Total hours**	54 class hours + 71 non-class hours = **125 total hours**

PROFESSORS

HURTADO HURTADO, JOSE IGNACIO
BERNAL RODRIGUEZ, DANIEL

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

ENAEE 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

RA240 **[!]** ***Conoce los fundamentos de la ciencia de los procesos de solidificación, tratamiento de caldo y diagramas de fase.***

LEARNING ACTIVITIES	*CH*	*NCH*	*TH*
Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams		12 h.	12 h.

Computer simulation exercises, individually and/or in teams	4 h.		4 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	22 h.	14 h.	36 h.
Carrying out exercises and solving problems individually and/or in teams	6 h.	6 h.	12 h.

EVALUATION SYSTEM	W
Individual written and/or oral tests or individual coding/programming tests	100%

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.

MAKE-UP MECHANISMS

Individual written and oral tests to assess technical skills of the subject

Comments: open-book

CH - Class hours: 32 h.
NCH - Non-class hours: 32 h.
TH - Total hours: 64 h.

RA241 **[!]** ***Conoce los fundamentos tecnológicos de los procesos de fundición y los optimiza mediante herramientas de simulación.***

LEARNING ACTIVITIES	CH	NCH	TH
Development and writing of records, reports, presentations, audiovisual material, etc. on projects/work experience/challenges/case studies/experimental investigations carried out individually and/or in teams		12 h.	12 h.
Computer simulation exercises, individually and/or in teams	8 h.	8 h.	16 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	8 h.	12 h.	20 h.
Carrying out exercises and solving problems individually and/or in teams	6 h.	7 h.	13 h.

EVALUATION SYSTEM	W
Individual written and/or oral tests or individual coding/programming tests	100%

MAKE-UP MECHANISMS

Individual written and oral tests to assess technical skills of the subject

CH - Class hours: 22 h.
NCH - Non-class hours: 39 h.
TH - Total hours: 61 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. Gibss 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. Aplications of solidification theories

LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources

Technical articles
Topic related web quires
Moodle Platform
Class presentations
Computer practical training
Specific Master Software
Slides of the subject

Bibliography

Serope Kalpakjian, Steven R. Schmid. Manufactura Ingeniería y tecnología, Pearson Educación, México, 2002

Phase Transformations in Metals and Alloys (Revised Reprint) By David A. Porter, Kenneth E. Easterling, Mohamed Youssef Abdelraouf Sherif, ISBN 9781420062106 Published February 3, 2009 by CRC Press