[MHH101] MATERIAL FORMING

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**	2.67	**Total hours**	48 class hours + 77 non-class hours = **125 total hours**

PROFESSORS

SAENZ DE ARGANDOÑA FERNANDEZ DE GOROSTIZA, ENEKO

MENDIGUREN OLAETA, JOSEBA

REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
(No specific previous subjects required)	*(No previous knowledge required)*

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

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

MHC48 - To work with people, getting them involved and guiding them towards the achievement of a common goal, with a global vision of work and its characteristics (quality, deadlines, etc.), taking individual and group interests into account

BASIC

M_CB10 - To have learning skills and the capacity for self-guided or independent subsequent learning.

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

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

RA213 **It deeply knows the sheet metal forming and forging processes, as well as fundamental concepts of the numerical methods used for optimization**

LEARNING ACTIVITIES	*CH*	*NCH*	*TH*
Individual study and work, tests and evaluations and check points	14 h.	21 h.	35 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: 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.

CH - Class hours: 14 h.
NCH - Non-class hours: 21 h.
TH - Total hours: 35 h.

RA214 It is able to evaluate the feasibility and robustness of a forming process by means of a numerical simulation code (FEM), and to propose suitable alternatives to the needs of the product and/or production

LEARNING ACTIVITIES	CH	NCH	TH
Individual study and work, tests and evaluations and check points	6 h.	16 h.	22 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: 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.

CH - Class hours: 6 h.
NCH - Non-class hours: 16 h.
TH - Total hours: 22 h.

RA215 It is able to propose and analyze a forming process as well as to design the needed supplies for its production starting from a final component geometry

LEARNING ACTIVITIES	CH	NCH	TH
Individual and team exercises	20 h.	38 h.	58 h.

EVALUATION SYSTEM	W	MAKE-UP MECHANISMS
Individual written and oral tests to assess technical skills of the subject	50%	Individual written and oral tests to assess technical skills of the subject
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices	50%	

Comments: 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.

CH - Class hours: 20 h.
NCH - Non-class hours: 38 h.
TH - Total hours: 58 h.

RA216 It knows the experimental methods for obtaining material and contact models for its application in a numerical simulation code (FEM)

LEARNING ACTIVITIES	CH	NCH	TH
Individual or team workshop and/or lab practice	8 h.	2 h.	10 h.

EVALUATION SYSTEM	W	MAKE-UP MECHANISMS
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices	100%	Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices

Comments: The failed tasks, training, etab. must be retaken and they will be valued with a maximum of a 5.

CH - Class hours: 8 h.
NCH - Non-class hours: 2 h.
TH - Total hours: 10 h.

CONTENTS

1st MODULE. Introduction and industrial use of FEM

Subject introduction

Why manufacturing process simulation?

Importance of the virtual manufacturing

2nd MODULE. Virtual manufacturing techniques

How to simulate the reality?

Agreement between accuracy and computational time

Numerical simulation commercial codes

3th MODULE. Numerical methods

How to solve the problem using a computer?

Time discretization

Spatial discretization

4th MODULE. Material behavior

How does the material behavior affect the result?

Metal forming plasticity model

Relevant material parameters

5th MODULE. Tribology

How to simulate the contact between bodies?

Contact algorithms

Characterization methods

6th MODULE. Machines and tool construction

Industrial machines for metal forming

Sheet metal forming tool materials and design

Forging tool materials and design

7th MODULE. Stamping software

Commercial stamping software

Simulation methodology

Results analysis

8th MODULE. Practical project

Real problem analysis

Application of the studied concepts

Real manufacturing virtual analysis

LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources	Bibliography
Subject notes	Banabic, D. Sheet Metal Forming Processes. Constitutive Modelling and Numerical Simulation, Elsevier, 2010. ISBN 978-3-540-88112-4
Presentations by external Lecturers	Lange, K. Handbook of metal forming. McGraw-Hill Book Company, 1985. ISBN-10: 0872634574
Labs	Schuler GmbH., & Schuler GmbH. Metal forming handbook. Springer Science & Business Media, 1998. ISBN 9783642637636
Technical articles	https://doi.org/10.1016/B978-0-323-31149-6.00013-X
Moodle Platform	https://doi.org/10.3390/met10010047
Class presentations	http://purl.org/utwente/59299
Specific Master Software	https://doi.org/10.1007/BF03266709
Lab practical training	https://doi.org/10.1007/BF03266709
Computer practical training	https://doi.org/10.1016/B978-1-78242-325-6.00011-6
Slides of the subject	https://www.businessinsider.com/car-companies-of-the-world-2016-12?IR=T
	http://www.sunyuu.es/cmm-holding-fixture-cmm/plastic-parts-cmm-holding-fixture-cmm/console-trim-bezels-cmm-holding-fixture.html
	https://doi.org/10.1016/j.ijlmm.2019.04.008
	https://doi.org/10.1016/j.cma.2019.03.004
	https://doi.org/10.1016/j.matdes.2009.10.050
	https://doi.org/10.1063/1.4963467
	https://doi.org/10.1016/j.cja.2014.04.015
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	https://www.handelsblatt.com/unternehmen/industrie/luxuslimousine-phaeton-vw-strategie-laesst-600-leiharbeiter-zittern/12728086.html?ticket=ST-2222148-2RrBqiLcxzeewCt216nL-ap2, September 2018
	https://www.stampingjournal-digital.com/stampingjournal/20180708/MobilePagedArticle.action?articleId=1413216#articleId1413216
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	https://doi.org/10.1016/j.matdes.2014.05.066
	DOI: 10.1007/s10853-020-04477-x
	ISO12004
	DOI: 10.1007/s00170-011-3254-1
	https://doi.org/10.1016/j.ijmecsci.2018.01.008
	https://doi.org/10.1016/j.ijmecsci.2018.01.008
	https://www.thefabricator.com/article/bending/minimum-versus-recommended-inside-bend-radius, September 2018
	http://www.nssmc.com/en/tech/report/nsc/pdf/103-04.pdf, September

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http://www.nssmc.com/en/tech/report/nsc/pdf/103-04.pdf, September 2018
https://www.ahssinsights.org/news/ahss-edge-stretching-limits/, September 2018
https://doi.org/10.1016/j.ijplas.2013.08.006
https://doi.org/10.1016/j.ijsolstr.2016.11.034
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DOI: 10.1051/matecconf/20168011003
https://doi.org/10.1007/s12289-017-1382-3
doi:10.4028/www.scientific.net/KEM.651-653.181
http://dx.doi.org/10.1016/j.ijmecsci.2014.03.015
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http://dx.doi.org/10.1016/j.matdes.2014.01.012
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http://www.dierk-raabe.com
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doi:10.1016/S0020-7403(03)00139-5
doi: 10.1007/s12289-010-0984-9
doi:10.1016/S0020-7403(03)00139-5
doi:10.1016/j.jmatprotec.2007.11.189
https://doi.org/10.1016/j.cja.2020.04.025
https://doi.org/10.1016/j.euromechsol.2011.05.006
DOI: 10.1007/s00366-009-0149-y
DOI: 10.1016/j.ijplas.2006.05.006
DOI: 10.1016/j.ijmecsci.2008.12.006
DOI: 10.1115/MSEC2011-50258
doi:10.1016/j.jmatprotec.2005.02.099
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DOI:10.1016/j.ijsolstr.2017.05.009