

## [GMG301] Process engineering I

### GENERAL INFORMATION

<b>Studies</b>	DEGREE IN MECHANICAL ENGINEERING	<b>Subject</b>	MANUFACTURING PROCESS ENGINEERING
<b>Semester</b>	1	<b>Course</b>	2
<b>Character</b>	COMPULSORY	<b>Mention / Field of specialisation</b>	
<b>Plan</b>	2022	<b>Modality</b>	Face-to-face
<b>Credits</b>	4,5	<b>Language</b>	EUSKARA/CASTELLANO
		<b>Hours/week</b>	3.78
		<b>Total hours</b>	67.99 class hours + 44.51 non-class hours = <b>112.5 total hours</b>

### 2030 AGENDA GOALS



### PROFESSORS

GARCIA CRESPO, CARLOS  
SUQUIA IMAZ, AITOR  
AZPI-ALDANONDO ECIOLAZA, JOSE RAMON (GOIERRI)  
TRINIDAD NARANJO, JAVIER

### REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
GRAPHIC EXPRESSION I	Basic concepts of mathematics: Geometry, trigonometry, interpolation, extrapolation... Basic concepts of physics: pressure, units...
GRAPHIC EXPRESSION II	

### LEARNING RESULTS

LEARNING RESULTS	KC	SK	AB	ECTS
<b>GMR207</b> - To demonstrate basic knowledge of production and manufacturing systems	x			4,02
<b>G-RTR1</b> - To develop interdisciplinary projects specific to their specialty and of gradual complexity, - becoming aware of respect for human rights and fundamental rights, and analyzing and assessing the impact of the proposed solutions on the SDGs - to acquire and/or apply basic, advanced and/or avant-garde, demonstrating the ability to work in multidisciplinary teams and/or undertake further studies with a high degree of autonomy		x		0,32
<b>G-RTR2</b> - To express information, ideas and the arguments that support them in an orderly, clear and coherent manner, orally and in writing, based on quality information, self-made or obtained from different sources, using inclusive and non-discriminatory language		x		0,16
<b>Total:</b>				<b>4,5</b>

KC: Knowledge or Content / SK: Skills / AB: Abilities

### ENAAE LEARNING RESULTS

- ENA102** - Knowledge and comprehension: Knowledge and comprehension of the engineering disciplines of their specialty, at the level necessary to acquire the rest of the competencies of the degree, including notions of the latest advances.
- ENA103** - Knowledge and comprehension: Awareness of the multidisciplinary context of engineering.
- ENA104** - Analysis in engineering: The ability to analyse complex products, processes and systems in their field of study; choose and apply relevant analytical, calculation and experimental methods in a suitable way; and correctly interpret the results of such analyses.
- ENA106** - Engineering projects: Ability to project, design and develop complex products (parts, components, finished products, etc.), processes and systems of their specialty, which meet the established requirements, including awareness of the social, health and safety, environmental, economic and industrial aspects, as well as selecting and applying appropriate project methods.
- ENA109** - Research and innovation: Ability to consult and apply codes of good practice and security in their specialty.
- ENA111** - Practical application of engineering: Understanding of the applicable techniques and methods for analysis, design and research and their limitations in the field of their specialty.
- ENA113** - Practical application of engineering: Knowledge of application of materials, equipment and tools, engineering technology and processes, and their limitations in the field of their specialty.
- ENA118** - Preparation of judgements: Ability to manage complex technical or professional activities or projects of their specialty, taking responsibility for decision making.
- ENA119** - Communication and Teamwork: Ability to effectively communicate information, ideas, problems and solutions in the field of engineering and with society in general.
- ENA120** - Communication and Teamwork: Ability to operate effectively in domestic and international contexts, individually and as a team, and to cooperate with both engineers and people from other disciplines.

### SECONDARY LEARNING RESULTS

**1RGM290** (1 sem)

LEARNING ACTIVITIES		CH	NCH	TH
Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams		1 h.	1 h.	2 h.
Tutoring sessions and monitoring of training activities		1 h.		1 h.
EVALUATION SYSTEM	W	MAKE-UP MECHANISMS		
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	85%	(No mechanisms)		
Observation (technical capacity, attitude and participation)	15%	<b>Comments:</b> Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings		
<b>Comments:</b> Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings				
<b>CH - Class hours:</b> 2 h.				
<b>NCH - Non-class hours:</b> 1 h.				
<b>TH - Total hours:</b> 3 h.				

1RGM293 (1 sem)			
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	,67 h.	,67 h.	1,34 h.
Tutoring sessions and monitoring of training activities	,66 h.		,66 h.
EVALUATION SYSTEM	W	MAKE-UP MECHANISMS	
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	100%	(No mechanisms)	
<b>Comments:</b> Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings		<b>Comments:</b> Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings	
<b>CH - Class hours:</b> 1,33 h.			
<b>NCH - Non-class hours:</b> ,67 h.			
<b>TH - Total hours:</b> 2 h.			

1RGM294 (1 sem)				
LEARNING ACTIVITIES		CH	NCH	TH
Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams		,67 h.	,67 h.	1,34 h.
Tutoring sessions and monitoring of training activities		,66 h.		,66 h.
EVALUATION SYSTEM	W	MAKE-UP MECHANISMS		
Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems	50%	(No mechanisms)		
Observation (technical capacity, attitude and participation)	50%	<b>Comments:</b> Ebaluazio jarraitua. Proiektuaren jarraipenean tutorearekin eta adituekin egindako bileretan jasotako FEEDBACK-a		
<b>Comments:</b> Ebaluazio jarraitua. Proiektuaren jarraipenean tutorearekin eta adituekin egindako bileretan jasotako FEEDBACK-a				
<b>CH - Class hours:</b> 1,33 h.				
<b>NCH - Non-class hours:</b> ,67 h.				
<b>TH - Total hours:</b> 2 h.				

**1RGM292 (1 sem)**

**LEARNING ACTIVITIES**

	<b>CH</b>	<b>NCH</b>	<b>TH</b>
Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams	,67 h.	,67 h.	1,34 h.
Tutoring sessions and monitoring of training activities	,66 h.		,66 h.

**EVALUATION SYSTEM**

**W**

Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	20%
Self-assessment	50%
Observation (technical capacity, attitude and participation)	30%

**Comments:** Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings

**MAKE-UP MECHANISMS**

(No mechanisms)

**Comments:** Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings

**CH - Class hours:** 1,33 h.

**NCH - Non-class hours:** ,67 h.

**TH - Total hours:** 2 h.

**RGM222 [I] Identifica y dimensiona la maquinaria, útiles, herramientas y parámetros de trabajo de varios procesos de fabricación**

**LEARNING ACTIVITIES**

	<b>CH</b>	<b>NCH</b>	<b>TH</b>
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	4 h.		4 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	29 h.	7 h.	36 h.
Carrying out exercises and solving problems individually and/or in teams	7 h.	4 h.	11 h.
Practical work in workshops and/or laboratories, individually and/or in teams	4 h.		4 h.

**Comments:** The practical exercises are carried out with state-of-the-art machines and equipment.

**EVALUATION SYSTEM**

**W**

Individual written and/or oral tests or individual coding/programming tests	100%
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**MAKE-UP MECHANISMS**

Individual written and/or oral tests or individual coding/programming tests

**CH - Class hours:** 44 h.

**NCH - Non-class hours:** 11 h.

**TH - Total hours:** 55 h.

**1RGM291 (1 sem)**

**LEARNING ACTIVITIES**

	<b>CH</b>	<b>NCH</b>	<b>TH</b>
Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams	1 h.	1 h.	2 h.
Tutoring sessions and monitoring of training activities	1 h.		1 h.

**EVALUATION SYSTEM**

**W**

Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	20%
Self-assessment	50%
Observation (technical capacity, attitude and participation)	30%

**Comments:** Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings

**MAKE-UP MECHANISMS**

(No mechanisms)

**Comments:** Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings

**CH - Class hours:** 2 h.

**NCH - Non-class hours:** 1 h.  
**TH - Total hours:** 3 h.

**RGM223 [!]** *Define el proceso de fabricación principal para una pieza dada*

**LEARNING ACTIVITIES**

Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams

Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects

**CH**

**NCH**

**TH**

23 h.

23 h.

2 h.

2 h.

**EVALUATION SYSTEM**

**W**

**MAKE-UP MECHANISMS**

Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems

100%

(No mechanisms)

**CH - Class hours:** 2 h.  
**NCH - Non-class hours:** 23 h.  
**TH - Total hours:** 25 h.

**RGM224 [!]** *Ser capaz de diseñar procesos de fabricación para determinadas piezas, conjugando criterios tecnológicos y económicos*

**LEARNING ACTIVITIES**

Carrying out/resolving projects/challenges/cases, etc. to provide solutions to problems in interdisciplinary contexts, real and/or simulated, individually and/or in teams

Tutoring sessions and monitoring of training activities

**CH**

**NCH**

**TH**

12 h.

6,5 h.

18,5 h.

2 h.

2 h.

**EVALUATION SYSTEM**

**W**

**MAKE-UP MECHANISMS**

Presentation and defence of exercises, case studies, computer practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems

50%

(No mechanisms)

Individual written and/or oral tests or individual coding/programming tests

50%

**CH - Class hours:** 14 h.  
**NCH - Non-class hours:** 6,5 h.  
**TH - Total hours:** 20,5 h.

## CONTENTS

0.- Manufacturing technologies: Introduction

1.- Casting processes

1.1.- Fundamentals of casting processes

1.2.- Permanent mold processes

1.3.- Non-permanent mold processes

1.4.- Special processes

1.5.- Basic concepts of mold design

2.- Forging

2.1.- Bases of the forging process

2.2.- Open die forging

2.3.- Closed die forging

2.4.- Design of dies for forging

3.- Sheet metal forming processes

3.1.- Fundamentals of cutting processes

3.2.- Fundamentals of bending processes

3.3.- Cylindrical deep drawing

4.- Welding

4.1.- Fundamentals of welding

4.2.- Fusion welding

- Oxyazethylene welding

- Electric arc welding with coated electrode

- MIG/MAG welding

- TIG welding

- Resistance welding

#### 4.3.- Solid state welding

- Friction welding

#### 5.- Plastic transformation processes

##### 5.1.- Injection process

- Introduction to injection mold design

##### 5.2.- Extrusion process

##### 5.3.- Blowing processes

##### 5.4.- Thermoforming

##### 5.5- Compression processes.

### LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources	Bibliography
Subject notes	Mikell P Groover Fundamentals of modern manufacturing Materials, Processes, and Systems, 7 th Edition Wiley Sons 2019 (ISBN 978-1-119-47521-7)
Moodle Platform	Manufactura Ingeniería y Tecnología Kalpakjian Schmid PRENTICE HALL (ISBN 970-2b-0137-1)
Class presentations	ASM Handbook. Vol.15: Casting ISBN electronic: 978-1-62708-187-0
Video projections	Complete Casting Handbook. John Campbell ISBN: 978-0-081-00120-2
Labs	Menges Georg, Michaeli Walter, Mohren Paul. How to Make Injection Molds (3rd Edition). Hanser Publishers; 2001. ISBN: 978-3-446-40180-8 / 978-3-446-21256-5