

## [GMK202] THERMAL ENGINEERING

### GENERAL INFORMATION

<b>Studies</b>	DEGREE IN MECHANICAL ENGINEERING	<b>Subject ?</b>
<b>Semester</b>	2	<b>Mention / Field of specialisation</b>
<b>Character</b>	COMPULSORY	<b>Language</b> ENGLISH
<b>Plan</b>	2017	<b>Total hours</b> 48 class hours + 64.5 non-class hours = <b>112.5 total hours</b>
<b>Credits</b>	4,5	<b>Hours/week</b> 2.67

### PROFESSORS

ESNAOLA RAMOS, JON ANDER  
PEÑALBA RETES, MARCEL  
SOUTO CANTELI, IÑIGO

### REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
THERMODYNAMICS	<i>(No previous knowledge required)</i>

### SKILLS

#### VERIFICA SKILLS

##### SPECIFIC

**GMCE03** - To have knowledge of applied thermal engineering

##### GENERAL

**GMCT01** - To be able to design, draft, sign and develop mechanical engineering projects for the construction, renovation, repair, maintenance, demolition, manufacture, installation, assembly and operation of structures, mechanical equipment, energy facilities, electric and electronic installations, industrial plants and facilities and manufacturing and automation processes.

**GMCT02** - To be able to manage and coordinate tasks in mechanical engineering projects

**GMCT03** - To build on basic concepts and technologies to expand knowledge of new theories and methods, and to acquire flexibility to adapt to new situations

**GMCT04** - To be able to take the initiative in problem solving, decision making, creativity, critical thinking, effective communication and the transfer of knowledge and skills in the field of mechanical engineering.

**GMCT05** - Possessing the knowledge for performing measurements, calculations, valuations, estimates, inspections, studies, reports, work plans and other similar tasks.

**GMCT06** - To be able to comply with specifications, regulations and standards

**GMCT10** - To be able to do their job in multilingual, multidisciplinary environments

**GMCT11** - Possessing the knowledge, understanding and ability to apply the legislation applicable to their work as an industrial engineering technician.

**GMCT12** - To be able to do their job in cooperative, participatory environments, with awareness of social responsibility.

##### CROSS

**GMCG02** - To be able to understand and apply knowledge to problem solving in complex work situations or specialised and professional environments calling for creative and innovative ideas, using self-developed arguments and procedures;

**GMCG03** - To be capable of gathering and interpreting data and information on which to base conclusions including, when necessary and pertinent, reflection on matters of a social, scientific or ethical nature in their field of study;

**GMCG04** - To be able to respond adequately in complex situations or situations that call for innovative solutions in both the academic field and work environments within their field of study;

**GMCG05** - To clearly and accurately communicate knowledge, methods, ideas, problems and solutions in their field of study to all kinds of audiences (both expert and lay);

**GMCG06** - To be able to identify their own training needs in their field of study and work environment and to organise their own autonomous learning process in all kinds of contexts (structured or not).

#### ENAAE LEARNING RESULTS

#### ECTS

**ENA102** - Knowledge and comprehension: Knowledge and comprehension of the engineering disciplines of their speciality, at the level necessary to acquire the rest of the competencies of the degree, including notions of the latest advances. 3,82

**ENA103** - Knowledge and comprehension: Awareness of the multidisciplinary context of engineering. 0,04

**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. 0,04

**ENA105** - Analysis in engineering: The ability to identify, formulate and solve engineering problems in their speciality; choose and apply adequately established analytical, calculation and experimental methods; and acknowledge the importance of social, health and safety, environmental, economic, and industrial restrictions. 0,04

**ENA106** - Engineering projects: Ability to project, design and develop complex products (parts, components, finished products, etc.), processes and systems of their speciality, 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. 0,04

**ENA107** - Engineering projects: Project capacity some state-of-the-art knowledge of their engineering speciality. 0,04

**ENA108** - Research and innovation: Ability to carry out bibliographic searches and consult and use databases and other 0,04

information sources with discretion, in order to carry out simulation and analysis with the aim of conducting research on technical topics of their speciality.

<b>ENA109</b> - Research and innovation: Ability to consult and apply codes of good practice and security in their speciality.	0,04
<b>ENA110</b> - Research and innovation: Capacity and ability to project and carry out experimental investigations, interpret results, and reach conclusions in their field of study.	0,04
<b>ENA111</b> - Practical application of engineering: Understanding of the applicable techniques and methods for analysis, design and research and their limitations in the field of their speciality.	0,04
<b>ENA112</b> - Practical application of engineering: Practical competency to solve complex problems, carry out complex engineering projects, and conduct investigations specific to their speciality.	0,04
<b>ENA113</b> - Practical application of engineering: Knowledge of application of materials, equipment and tools, engineering technology and processes, and their limitations in the field of their speciality.	0,04
<b>ENA115</b> - Practical application of engineering: Knowledge of the social, health and safety, environmental, economic and industrial implications of engineering practice.	0,04
<b>ENA118</b> - Preparation of judgements: Ability to manage complex technical or professional activities or projects of their speciality, taking responsibility for decision making.	0,04
<b>ENA119</b> - Communication and Teamwork: Ability to effectively communicate information, ideas, problems and solutions in the field of engineering and with society in general.	0,04
<b>ENA120</b> - 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.	0,04
<b>ENA121</b> - Continued training: Ability to acknowledge the need for their own continued training and to undertake this activity throughout their professional life independently.	0,04
<b>ENA122</b> - Continued training: Ability to stay up to date on science and technology innovations.	0,04

**Total:** **4,5**

## LEARNING RESULTS

**RG304 Define the problem, develop the solution and present the conclusions in a efficient manner, arguing and justifying each one of them in writing.**

LEARNING ACTIVITIES	W	CH	NCH	TH
Development, writing and presentation of memorandums, reports, audiovisual material, etc. Relating to projects/POPBLs carried out individually or in teams	100%	1 h.	3 h.	4 h.
<b>EVALUATION SYSTEM</b>				<b>MAKE-UP MECHANISMS</b>
Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence				Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence
<b>Comments:</b> The evaluation of the semester project will be continuous and is based on the meetings that the teams will hold with the tutors and experts. One week before the final delivery of the report, the joint work will be analyzed to identify the aspects to improve and communicate to the team. The final version of the report with the aspects to improve corrected will be the recovery.				
<b>CH - Class hours:</b> 1 h. <b>NCH - Non-class hours:</b> 3 h. <b>TH - Total hours:</b> 4 h.				

**RG305 Define the problem, develop the solution and present the conclusions in a efficient manner, arguing and justifying each one of them in spoken form.**

LEARNING ACTIVITIES	W	CH	NCH	TH
Development, writing and presentation of memorandums, reports, audiovisual material, etc. Relating to projects/POPBLs carried out individually or in teams	100%	1 h.	3 h.	4 h.
<b>EVALUATION SYSTEM</b>				<b>MAKE-UP MECHANISMS</b>
Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence				Individual written and oral tests to assess technical skills of the subject
<b>Comments:</b> The evaluation of the semester project will be continuous and is based on the meetings that the teams will hold with the tutors and experts. One week before the final delivery of the report, the joint work will be analyzed to identify the aspects to improve and communicate to the team. The final version of the report with the aspects to improve corrected will be the recovery.				

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

**NCH - Non-class hours:** 3 h.

**TH - Total hours:** 4 h.

**RGM318 Analyses the mechanisms of heat transfer (conduction, convection and radiation)**
**LEARNING ACTIVITIES**

		<i>CH</i>	<i>NCH</i>	<i>TH</i>
Development, writing and presentation of memorandums, reports, audiovisual material, etc.		6 h.	8 h.	14 h.
Relating to projects/POPBLs carried out individually or in teams				
Individual study and work, tests and evaluations and check points		2 h.	7 h.	9 h.
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects		14 h.	14 h.	28 h.

**EVALUATION SYSTEM**

	<i>W</i>	<b>MAKE-UP MECHANISMS</b>
Individual written and oral tests to assess technical skills of the subject	75%	Individual written and oral tests to assess technical skills of the subject
Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence	25%	Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence <b>Comments:</b> The evaluation of the semester project will be continuous and is based on the meetings that the teams will hold with the tutors and experts. One week before the final delivery of the report, the joint work will be analyzed to identify the aspects to improve and communicate to the team. The final version of the report with the aspects to improve corrected will be the recovery.

**CH - Class hours:** 22 h.

**NCH - Non-class hours:** 29 h.

**TH - Total hours:** 51 h.

**RGM319 Designs and dimensions the components of heat transfer among fluids**
**LEARNING ACTIVITIES**

		<i>CH</i>	<i>NCH</i>	<i>TH</i>
Development, writing and presentation of memorandums, reports, audiovisual material, etc.		4 h.	6,5 h.	10,5 h.
Relating to projects/POPBLs carried out individually or in teams				
Individual study and work, tests and evaluations and check points		2 h.	6 h.	8 h.
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects		14 h.	11 h.	25 h.

**EVALUATION SYSTEM**

	<i>W</i>	<b>MAKE-UP MECHANISMS</b>
Individual written and oral tests to assess technical skills of the subject	75%	Individual written and oral tests to assess technical skills of the subject
Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence	25%	Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence <b>Comments:</b> The evaluation of the semester project will be continuous and is based on the meetings that the teams will hold with the tutors and experts. One week before the final delivery of the report, the joint work will be analyzed to identify the aspects to improve and communicate to the team. The final version of the report with the aspects to improve corrected will be the recovery.

**CH - Class hours:** 20 h.

**NCH - Non-class hours:** 23,5 h.

**TH - Total hours:** 43,5 h.

**RG302 Analyze the intervening variables in the problem and propose actions for a stable situation.**
**LEARNING ACTIVITIES**

		<i>CH</i>	<i>NCH</i>	<i>TH</i>
Development, writing and presentation of memorandums, reports, audiovisual material, etc.		2 h.	3 h.	5 h.

**EVALUATION SYSTEM**

	<i>W</i>	<b>MAKE-UP MECHANISMS</b>
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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
<b>Comments:</b> The evaluation of the semester project will be continuous and is based on the meetings that the teams will hold with the tutors and experts. One week before the final delivery of the report, the joint work will be analyzed to identify the aspects to improve and communicate to the team. The final version of the report with the aspects to improve corrected will be the recovery.		
<b>CH - Class hours:</b> 2 h. <b>NCH - Non-class hours:</b> 3 h. <b>TH - Total hours:</b> 5 h.		

<b>LEARNING ACTIVITIES</b>	<b>W</b>	<b>CH</b>	<b>NCH</b>	<b>TH</b>			
Development, writing and presentation of memorandums, reports, audiovisual material, etc. Relating to projects/POPBLs carried out individually or in teams	100%	2 h.	3 h.	5 h.			
<b>EVALUATION SYSTEM</b>							
Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence	100%	<b>MAKE-UP MECHANISMS</b>					
<b>Comments:</b> The evaluation of the semester project will be continuous and is based on the meetings that the teams will hold with the tutors and experts. One week before the final delivery of the report, the joint work will be analyzed to identify the aspects to improve and communicate to the team. The final version of the report with the aspects to improve corrected will be the recovery.							
<b>CH - Class hours:</b> 2 h. <b>NCH - Non-class hours:</b> 3 h. <b>TH - Total hours:</b> 5 h.							

## CONTENTS

- 1 - Introduction to heat transfer mechanisms: Conduction, convection and radiation
- 2 - Heat diffusion equation
- 3 - Extended surfaces: Fins
- 4 - Convection
- 5 - Design of heat interchangers
- 6 - Methodology for problem solving and communication

## LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources	Bibliography
Subject notes	Heat Transfer A Practical Approach, Cengel, Yunus A and Cengel, Yunus, McGraw Hill Professional, 2003.
Topic related web quires	Fundamentals of heat and mass transfer, Incropera Frank, Dewitt David, Bergman Theodore, Lavine Adrienne, sixth edition, 2011.
Moodle Platform	John H. Lienhard IV and John H. Lienhard V, third edition, Cambridge MA, Phlogiston Press, 2004.
Class presentations	
Video projections	
Slides of the subject	



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INGENIARITZA TERMIKOA  
IKASGAIAN EGINDAKO EGOKITZAPENAK-

2020 - Apirila

# TESTUINGURUA / CONTEXTO

2019-20 ikasturte honetan COVID19 pandemiak eragindako alarma-egoera dela eta, berez aurrez aurreko ikasketak direnak on line modalitatera egokitu behar izan ditu MONDRAGON UNIBERTSITATEko Goi Eskola Politeknikoak GRADU ZEIN MASTER-etako tituluetan.	El estado de alarma sobrevenido por la pandemia de COVID19 en el presente curso 2019-20, ha llevado a la Escuela Politécnica Superior de MONDRAGON UNIBERTSITATEA a impartir en modo online, formación de títulos de GRADO Y MÁSTER que fueron diseñados para impartir en modo presencial
Egokitzapen honek bi jarduera motatan eragin dio nagusiki ikaskuntzari: <b>-FORMAZIO JARDUERETAN</b> <b>-EBALUAZIO JARDUERETAN</b>	Esta adaptación ha afectado principalmente a dos tipos de actividades: <b>-ACTIVIDADES DE FORMACIÓN</b> <b>-ACTIVIDADES DE EVALUACIÓN</b>



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# FORMAZIO JARDUERAK

## Actividades formativas

# FORMAZIO JARDUERAK

PROGRAMAREN ATALA (ezagutzak edo ikaste emaitzak)	AURREIKUSITAKO JARDUERAK	EGOERA BERRIRA EGOKITUTAKO JARDUERAK
RGM318	<ul style="list-style-type: none"> <li>• Klase magistrala</li> <li>• Gai bakoitzari dagokion erronka bat (2 erronka guztira)</li> <li>• Kontrol puntuak</li> </ul>	(Itxialdia hasterako ikastemaitza honi dagozkion jarduerak bukatuta zeuden, ebaluaziorako kontrol puntuak barne)
RGM319	<p>Klase magistrala        Gai bakoitzari dagokion erronka bat (2 erronka guztira)        Kontrol puntuak</p>	<ul style="list-style-type: none"> <li>• Klasea online:           <ul style="list-style-type: none"> <li>• Atal teorikoa bideo-tutorialen bidez</li> <li>• Ariketak Matlab Publish erabilera</li> </ul> </li> <li>• Kontrol jarduerak:           <ul style="list-style-type: none"> <li>• Klasean eginako ariketak Mudle-en bidez jaso klasero</li> <li>• Gai bakoitzari dagokion erronka bat (2 erronka guztira)</li> </ul> </li> <li>• Ebaluazioa:           <ul style="list-style-type: none"> <li>• Kontrol puntuak online</li> </ul> </li> </ul>

**OHARRA; moldaketa edo egokitzapenik egin ez den kasuan, taula hutsik egongo da.**



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# EBALUAZIO JARDUERAK

## Actividades de evaluación

# EBALUAZIO JARDUERAK

PROGRAMAREN ATALA (Ikaste emaitzak)	AURREIKUSITAKO JARDUERA/K	AURREIKUSITAKO JARDUERAREN PISUA (Azken notarekiko)	EGOERA BERRIRA EGOKITUTAKO JARDUERAK	EMANDAKO PISUA (Azken notarekiko)
RGM318	Kontrol puntuia	%75	(Itxialdia hasterako ikastemaitza honi dagozkion jarduerak bukatuta zeuden, ebaluaziorako kontrol puntuia barne)	
	Taldekako proiektua	%25		
RGM319			Kontrol puntuia	%75
			Taldekako proiektua	%25

**OHARRA; moldaketa edo egokitzapenik egin ez den kasuan, taula hutsik egongo da.**



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**Eskerrik asko  
Muchas gracias  
Thank you**

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