[GMK301] THERMODYNAMICS

GENERAL INFORMATION

Studies	DEGREE IN MECHANICAL ENGINEERING			**Subject**	THERMAL ENGINEERING
Semester	2	**Course**	2	**Mention / Field of specialisation**	
Character	COMPULSORY				
Plan	2022	**Modality**	Face-to-face	**Language**	EUSKARA/CASTELLANO
Credits	4,5	**Hours/week**	3.78	**Total hours**	68.02 class hours + 44.48 non-class hours = **112.5 total hours**

2030 AGENDA GOALS

PROFESSORS

BERASATEGUI AROSTEGUI, JOANES
IGLESIAS SANCHEZ, ASIER
ERRARTE YARZA, ANE

REQUIRED PREVIOUS KNOWLEDGE

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

LEARNING RESULTS

LEARNING RESULTS	KC	SK	AB	ECTS
GMR204 - To demonstrate knowledge of thermodynamics and heat transmission and its application to solving problems in the field of engineering			*x*	4,02
G-RTR1 - 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
G-RTR2 - 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
			Total:	4,5

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

ENAEE LEARNING RESULTS

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.

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 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.

ENA111 - Practical application of engineering: Understanding of the applicable techniques and methods fr analysis, design and research and their limitations in the field of their speciality.

ENA118 - Preparation of judgements: Ability to manage complex technical or professional activities or projects of their speciality, 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

2RGM293 **(2 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	1,34 h.	,66 h.	2 h.

EVALUATION SYSTEM	W	MAKE-UP MECHANISMS
Reports on the completion of exercises, case studies,	100%	Presentation and defence of exercises, case studies, computer

computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems

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

practical work, simulation practical work, laboratory practical work, term projects, end of degree project, master's thesis, challenges and problems

Comments: The evaluation of the semester project will be continuous and will be based on the meetings of the team with the tutor and the experts. One week before the final delivery of the report, the work as a whole will be analysed, the necessary improvements will be defined and communicated to the team. Improvements must be made before the delivery of the final version of the report.

CH - Class hours: 1,34 h.
NCH - Non-class hours: ,66 h.
TH - Total hours: 2 h.

2RGM294 (2 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	1,34 h.	,66 h.	2 h.

EVALUATION SYSTEM	W
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	100%

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

MAKE-UP MECHANISMS

(No mechanisms)

Comments: The evaluation of the semester project will be continuous and will be based on the meetings of the team with the tutor and the experts. One week before the final delivery of the report, the work as a whole will be analysed, the necessary improvements will be defined and communicated to the team. Improvements must be made before the delivery of the final version of the report.

CH - Class hours: 1,34 h.
NCH - Non-class hours: ,66 h.
TH - Total hours: 2 h.

RGM212 [!] *Distingue estados de agregación de sustancias puras y utiliza modelos apropiados para calcular sus propiedades termodinámicas. Analiza y discute balances de masa y energía de procesos y ciclos termodinámicos en sistemas cerrados*

LEARNING ACTIVITIES	CH	NCH	TH
Personal study and flexible development of concepts and subjects using active dynamics, to foster more meaningful learning	2 h.	5 h.	7 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	14 h.		14 h.
Carrying out exercises and solving problems individually and/or in teams	6 h.	7 h.	13 h.

EVALUATION SYSTEM	W
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	10%
Individual written and/or oral tests or individual coding/programming tests	90%

MAKE-UP MECHANISMS

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

Comments: Retakes for both checkpoints will be performed on the same day. If you do not achieve a score of 4 in a checkpoint, you must make a recovery. After the retakes, the criteria for calculating the grade: 25% first choice + 75% second choice.

CH - Class hours: 22 h.
NCH - Non-class hours: 12 h.
TH - Total hours: 34 h.

RGM214 **[!]** ***Analiza y discute el rendimiento, la viabilidad y la reversibilidad de los procesos termodinámicos y las máquinas térmicas***

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	2 h.	10,5 h.	12,5 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	6 h.	2 h.	8 h.

EVALUATION SYSTEM	W
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	100%

Comments: Students have the responsability of meeting the experts to do the tracking of the project and to ensure the achievement of the goals.

MAKE-UP MECHANISMS

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

Comments: The evaluation of the semester project will be continuous and will be based on the meetings of the team with the tutor and the experts. One week before the final delivery of the report, the work as a whole will be analysed, the necessary improvements will be defined and communicated to the team. Improvements must be made before the delivery of the final version of the report.

CH - Class hours: 8 h.
NCH - Non-class hours: 12,5 h.
TH - Total hours: 20,5 h.

2RGM291 **(2 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	2 h.	1 h.	3 h.

EVALUATION SYSTEM	W
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	50%
Self-assessment	50%

Comments: Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings The average of the marks of the tutor's assessment and the self-assessment carried out by the work team is calculated, using the defined rubrics. Afterwards, the final mark is calculated by multiplying the average mark by a factor calculated on the basis of the co-evaluation among the members of the group.

MAKE-UP MECHANISMS

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

Comments: The evaluation of the semester project will be continuous and will be based on the meetings of the team with the tutor and the experts. One week before the final delivery of the report, the work as a whole will be analysed, the necessary improvements will be defined and communicated to the team. Improvements must be made before the delivery of the final version of the report.

CH - Class hours: 2 h.
NCH - Non-class hours: 1 h.
TH - Total hours: 3 h.

2RGM292 **(2 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	1,34 h.	,66 h.	2 h.

EVALUATION SYSTEM	W
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	50%

MAKE-UP MECHANISMS

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

Comments: The evaluation of the semester project will be

Self-assessment	50%	

Comments: Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings The average of the marks of the tutor's assessment and the self-assessment carried out by the work team is calculated, using the defined rubrics. Afterwards, the final mark is calculated by multiplying the average mark by a factor calculated on the basis of the co-evaluation among the members of the group.

Comments: The evaluation of the semester project will be continuous and will be based on the meetings of the team with the tutor and the experts. One week before the final delivery of the report, the work as a whole will be analysed, the necessary improvements will be defined and communicated to the team. Improvements must be made before the delivery of the final version of the report.

CH - Class hours: 1,34 h.
NCH - Non-class hours: ,66 h.
TH - Total hours: 2 h.

RGM213 **[!]** ***Analiza y discute balances de masa y energía de procesos y ciclos termodinámicos en sistemas abiertos, utilizando el segundo principio de la termodinámica y el concepto de entropía***

LEARNING ACTIVITIES	CH	NCH	TH
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	2 h.	8 h.	10 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	16 h.		16 h.
Carrying out exercises and solving problems individually and/or in teams	12 h.	8 h.	20 h.

EVALUATION SYSTEM	W
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	10%
Individual written and/or oral tests or individual coding/programming tests	90%

MAKE-UP MECHANISMS

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

Comments: Retakes for both checkpoints will be performed on the same day. If you do not achieve a score of 4 in a checkpoint, you must make a recovery. After the retakes, the criteria for calculating the grade: 25% first choice + 75% second choice.

CH - Class hours: 30 h.
NCH - Non-class hours: 16 h.
TH - Total hours: 46 h.

2RGM290 **(2 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	2 h.	1 h.	3 h.

EVALUATION SYSTEM	W
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	100%

MAKE-UP MECHANISMS

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

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

Comments: The evaluation of the semester project will be continuous and will be based on the meetings of the team with the tutor and the experts. One week before the final delivery of the report, the work as a whole will be analysed, the necessary improvements will be defined and communicated to the team. Improvements must be made before the delivery of the final version of the report.

CH - Class hours: 2 h.
NCH - Non-class hours: 1 h.
TH - Total hours: 3 h.

CONTENTS

1. Fundamentals:

Thermodynamic properties of fluidsThermodynamic transformationsThermodynamic states / transformations / cycles

2. Properties:

Classification of substances and the definition of states and phasesClassification of fluids - Ideal and real gasesP-v-T diagrams for substances in equilibrium

3. First principle of thermodynamics:

Heat, work and transformationsClosed systemsOpen systems.

4. Second principle of thermodynamics:

Sense of spontaneous processes and the concept of power qualityEfficiency of heat/cold engines and machinesReversible and irreversible processesReversible thermodynamic cycles

5. Thermal machines

LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources	Bibliography
Subject notes Moodle Platform Class presentations	Fundamentals of engineering thermodynamics / Michael J. Moran, Howard N. Shapiro. Editorial: Wiley. Año de impresión: 2014 ISBN: 9781118412930 Termodinamika makroskopikoa / Jose Mari Elortza. Editorial: Boan. Año de impresión: 1991. ISBN: 84-86967-34-1 TERMODINAMIKA klasikoaren oinarriak / Luis M. Bandres. Editorial: Elhuyar. Año de impresión: 1983 ISBN: 84-86158-02-3 Termodinámica / Yunus A. Çengel, Michael A. Boles. Editorial McGraw-Hill. Año de impresión: 2015. ISBN: 978-1-4562-4288-6 (online), 978-607-15-1281-9 (papel)