



	[GMK301] THER	MODYNAMIC	CS			
	GENERAL IN	FORMATION				
Studies DEGREE IN MECH	HANICAL ENGINEERING	Subject	THERMAL ENGIN	EERING		
Semester 2	Course 2	Mention / Field of				
Character COMPULSORY		specialisation				
Plan 2022	Modality Face-to-face	Language	EUSKARA/CASTE	LLANO		
Credits 4,5	Hours/week 3.78	Total hours	68.02 class hours	+ 44.48 n	on-class	hours = <u>112</u>
	2030 AGEN	DA GOALS				
B Electronic Model D Electronic Model D Electronic Model Model Model D Electronic Model D Electronic Model						
	PROFES	SSORS				
BERASATEGUI AROSTEGUI,	JOANES					
IGLESIAS SANCHEZ, ASIER						
ERRARTE YARZA, ANE						
	REQUIRED PREVIO	OUS KNOWLED	GE			
Subjec	ts		Knowled	ge	0	
(No specific previous s	ubjects required)		lo previous knowle	dge requii	red)	_
	LEARNING	RESULTS	К	: SK	AB	ECTS
MR204 - To demonstrate knowledge	of thermodynamics and heat trar	smission and its app	lication to		x	4,02
olving problems in the field of engine -RTR1 - To develop interdisciplinary ecoming aware of respect for humar hpact of the proposed solutions on the vant-garde, demonstrating the ability	vering projects specific to their specialty rights and fundamental rights, ar he SDGs - to acquire and/or apply to work in multidisciplinary team	r and of gradual comp nd analyzing and ass y basic, advanced an s and/or undertake fu	plexity, - essing the d/or ırther studies	x		0,32
ith a high degree of autonomy -RTR2 - To express information, idea oherent manner, orally and in writing ources, using inclusive and non-disc	as and the arguments that suppor , based on quality information, se riminatory language	t them in an orderly, If-made or obtained f	clear and from different	x		0,16
					Total:	4,5
C: Knowledge or Content / SK: Skills / AB: Ab	vilities					
ENAEE LEARNING RESULTS	alon Knowladza and comprehen	aion of the engineerin	na diasialiana of the		the of the	
ENAID2 - Knowledge and compreher necessary to acquire the rest of the c	competencies of the degree, inclu-	ding notions of the la	ng disciplines of the test advances.	eir speciai	ity, at the	e level
ENA104 - Analysis in engineering: The elevant analytical, calculation and e	e ability to analyse complex produces a suitable	ucts, processes and s way; and correctly in	systems in their fiel	d of study of such ar	; choose nalyses.	and apply
ENA106 - Engineering projects: Ability processes and systems of their spec environmental, economic and industr	y to project, design and develop of iality, which meet the established rial aspects, as well as selecting a	complex products (pa requirements, includi and applying appropri	rts, components, fir ing awareness of th ate project method	nished pro ne social, s.	oducts, et health ar	c.), id safety,
ENA111 - Practical application of eng	ineering: Understanding of the ap eciality.	plicable techniques a	and methods fr ana	lysis, desi	gn and re	esearch and
heir limitations in the field of their sp	•					
heir limitations in the field of their sp ENA118 - Preparation of judgements: responsibility for decision making.	Ability to manage complex techn	ical or professional a	ctivities or projects	of their sp	beciality,	taking
heir limitations in the field of their sp ENA118 - Preparation of judgements: esponsibility for decision making. ENA119 - Communication and Teamy engineering and with society in gene	Ability to manage complex techn work: Ability to effectively communical.	ical or professional a	ctivities or projects eas, problems and	of their sp solutions	in the fiel	taking d of
heir limitations in the field of their sp ENA118 - Preparation of judgements: responsibility for decision making. ENA119 - Communication and Team engineering and with society in gene ENA120 - Communication and Team and to cooperate with both engineers	Ability to manage complex techn work: Ability to effectively communitian ral. work: Ability to operate effectively and people from other discipline	ical or professional a nicate information, ide in domestic and inter s.	ctivities or projects eas, problems and rnational contexts,	of their sp solutions individuall	beciality, in the fiel y and as	taking d of a team,
their limitations in the field of their sp ENA118 - Preparation of judgements: responsibility for decision making. ENA119 - Communication and Teams engineering and with society in gene ENA120 - Communication and Teams and to cooperate with both engineers	Ability to manage complex techn work: Ability to effectively communital. work: Ability to operate effectively and people from other discipline SECONDARY LEA	ical or professional a nicate information, ide in domestic and inter s. RNING RESULT	ctivities or projects eas, problems and rnational contexts, S	of their sp solutions individuall	beciality, in the fiel y and as	taking d of a team,
their limitations in the field of their sp ENA118 - Preparation of judgements: responsibility for decision making. ENA119 - Communication and Team engineering and with society in gene ENA120 - Communication and Team and to cooperate with both engineers 2RGM293 (2 sem)	Ability to manage complex techn work: Ability to effectively commun ral. work: Ability to operate effectively and people from other discipline SECONDARY LEA	ical or professional a nicate information, ide in domestic and inter s. <u>RNING RESULT</u>	ctivities or projects eas, problems and rnational contexts, 'S	of their sp solutions individuall	beciality, in the fiel y and as	taking d of a team,
heir limitations in the field of their sp ENA118 - Preparation of judgements: responsibility for decision making. ENA119 - Communication and Team engineering and with society in gene ENA120 - Communication and Team and to cooperate with both engineers 2RGM293 (2 sem) LEARNING ACTIVITIES	Ability to manage complex techn work: Ability to effectively commun ral. work: Ability to operate effectively and people from other discipline SECONDARY LEA	ical or professional a nicate information, ide in domestic and inter s. <u>RNING RESULT</u>	ctivities or projects eas, problems and rnational contexts, S Сн	of their sp solutions individuall	peciality, in the fiel y and as	taking d of a team,
heir limitations in the field of their sp ENA118 - Preparation of judgements: responsibility for decision making. ENA119 - Communication and Team angineering and with society in gene ENA120 - Communication and Team and to cooperate with both engineers CRGM293 (2 sem) LEARNING ACTIVITIES Development and writing of record projects/work experience/challenge individually and/or in teams	Ability to manage complex techn work: Ability to effectively commun- ral. work: Ability to operate effectively and people from other discipline SECONDARY LEA s, reports, presentations, audiovis s/case studies/experimental inve	ical or professional a nicate information, ide in domestic and inter s. RNING RESULT sual material, etc. on stigations carried out	ctivities or projects eas, problems and mational contexts, S CH 1,34 h.	of their sp solutions individuall NCH ,66 h.	peciality, in the fiel y and as y and as <u>Th</u> 2 t	taking d of a team,





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			СН	NCH	тн
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 MECHANI	SMS		
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 Comments: Continuous evaluation. FEEDBACK received tutor and the experts in the project follow-up meetings	ACCORTION STSTERM MAKE-OP MECHAN resentation and defence of exercises, case studies, nputer practical work, simulation practical work, oratory practical work, term projects, end of degree iject, master's thesis, challenges and problems mments: Continuous evaluation. FEEDBACK received from the and the experts in the project follow-up meetings The evaluation of the report. MAKE-OP MECHAN Comments: The evaluation of the experts. The evaluation of the evaluation of the report.		(No mecha uation of the s based on the one week befo hole will be ar efined and co made before	anisms) semester proj meetings of th ore the final do halysed, the n mmunicated t the delivery o	ect will be he team with the elivery of the ecessary o the team. of the final version

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			СН	NCH	тн
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 participa procedures associated with the subjects	atory class	es, of concepts and	14 h.		14 h.
Carrying out exercises and solving problems individually	and/or in	teams	6 h.	7 h.	13 h.
EVALUATION SYSTEM	W	MAKE-UP MECHANIS	MS		
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	10%	Individual written and/or coding/programming tes Comments: Retakes fo	r oral tests sts r both che	or individual ckpoints will be	e performed on the
Individual written and/or oral tests or individual coding/programming tests	90%	same day. If you do not a must make a recovery. A the grade: 25% first choic	achieve a s fter the reta ce + 75% s	core of 4 in a c akes, the criter econd choice.	checkpoint, you ia for calculating
CH - Class hours: 22 h. NCH - Non-class hours: 12 h. TH - Total hours: 34 h.					





7

RGM214 [!] Analiza y discute el rendimiento, la viabilio térmicas	dad y la r	eversibilidad de los proce	sos tern	nodinámicos y	las máquinas
LEARNING ACTIVITIES			СН	NCH	ТН
Carrying out/resolving projects/challenges/cases, etc. to pi	rovide sol	utions to problems in	2 h.	10,5 h.	12,5 h.
interdisciplinary contexts, real and/or simulated, individuall Presentation by the teacher in the classroom, in participate	y and/or i ory classe	n teams s, of concepts and	6 h.	2 h.	8 h.
procedures associated with the subjects					
EVALUATION SYSTEM	W	MAKE-UP MECHANISN	IS		
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems Comments: Students have the responsability of meeting the experts to do the tracking of the project and to ensure the achievement of the goals.	100%	Reports on the completic exercises, simulation exe projects, challenges and Comments: The evaluat continuous and will be bas tutor and the experts. One report, the work as a whol improvements will be defir Improvements must be may of the report.	on of exe ercises, la problem ion of the sed on the week be e will be ned and o ade befor	rcises, case stud aboratory exerci s e semester proje e meetings of th efore the final de analysed, the ne communicated to re the delivery of	dies, computer ses, term ect will be e team with the livery of the ecessary o the team. i the final version
CH - Class hours: 8 h. NCH - Non-class hours: 12,5 h. TH - Total hours: 20,5 h.					
2RGM291 (2 sem) LEARNING ACTIVITIES Complete out/resolving projects/shallenges/segan_sta_ta_a	rovido ast	utions to problems in	CH 2 h	NCH	TH 3.b
 Carrying out/resolving projects/challenges/cases, etc. to priinterdisciplinary contexts, real and/or simulated, individual 	rovide sol y and/or i	utions to problems in n teams	∠ n.	1 n .	3 N.
EVALUATION SYSTEM	w	MAKE-UP MECHANISM	IS		
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems Self-assessment Comments: Continuous evaluation. FEEDBACK received tutor and the experts in the project follow-up meetings The a of the marks of the tutor's assessment and the self-assessm carried out by the work team is calculated, using the defined Afterwards, the final mark is calculated by multiplying the av mark by a factor calculated on the basis of the co-evaluation the members of the group.	50% from the average nent d rubrics. rerage n among	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 s. 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			СН	NCH	тн
Carrying out/resolving projects/challenges/cases, etc. to printerdisciplinary contexts, real and/or simulated, individual	rovide sol y and/or i	utions to problems in n teams	1,34 h.	,66 h.	2 h.
EVALUATION SYSTEM	w	MAKE-UP MECHANISM	IS		
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	50%	Reports on the completion exercises, simulation exercises, challenges and Comments: The evaluat	on of exe ercises, la problem ion of the	rcises, case stud aboratory exerci s e semester proje	dies, computer ses, term ect will be





Self-assessment Comments: Continuous evaluation. FEEDBACK received fro tutor and the experts in the project follow-up meetings The ave of the marks of the tutor's assessment and the self-assessmer carried out by the work team is calculated, using the defined ru Afterwards, the final mark is calculated by multiplying the aver mark by a factor calculated on the basis of the co-evaluation a the members of the group.	50% om the erage nt ubrics. rage among	continuous and will be bas tutor and the experts. One report, the work as a whole improvements will be defin Improvements must be ma of the report.	ed on the week be will be a ed and c de befor	e meetings of th fore the final de analysed, the no ommunicated to e the delivery o	he team with the elivery of the ecessary o the team. If the final version
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 energa utilizando el segundo principio de la termodinámica y el c	ía de pr concept	ocesos y ciclos termodina o de entropía	ámicos e	en sistemas ab	piertos,
			<u>си</u>	NCH	TU
Conducting tests, giving presentations, presenting defences,	, taking	examinations and/or doing	2 h.	8 h.	10 h.
checkpoints Presentation by the teacher in the classroom, in participatory	y classe	s, of concepts and	16 h.		16 h.
procedures associated with the subjects Carrying out exercises and solving problems individually and	l/or in te	ams	12 h.	8 h.	20 h.
	W	MAKE-UP MECHANISM	s		
Individual written and/or oral tests or individual coding/programming tests CH - Class hours: 30 h. NCH - Non-class hours: 16 h. TH - Total hours: 46 h. 2RGM290 (2 sem)	90%	same day. If you do not ac must make a recovery. Aft the grade: 25% first choice	hieve a s er the ret + 75% s	core of 4 in a c akes, the criter second choice.	heckpoint, you ia for calculating
LEARNING ACTIVITIES			СН	NCH	ТН
Carrying out/resolving projects/challenges/cases, etc. to provinterdisciplinary contexts, real and/or simulated, individually a	vide soli and/or ii	utions to problems in n 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% Comments: Continuous evaluation. FEEDBACK received from the tutor and the experts in the project follow-up meetings 100% Comments: Notice the experts on the completion of the exercises, laboratory exercises, term projects, challenges and problems 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. 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 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 / c ycles

2. Properties:

 $\label{eq:classification} Classification of substances and the definition of states and phases Classification of fluids - Ideal and real gases P-v-T diagrams for substances in equilibrium$

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 machin esReversible 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)			