[MSA102] FUNDAMENTALS OF THERMAL DESIGN

GENERAL INFORMATION

Studies	MASTER DEGREE IN SMART ENERGY SYSTEMS			**Subject**	?
Semester	1	**Course**	1	**Mention / Field of specialisation**	
Character	COMPULSORY				
Plan	2025	**Modality**	Face-to-face	**Language**	EUSKARA/CASTELLANO
Credits	4,5	**Hours/week**	0	**Total hours**	63 class hours + 49.5 non-class hours = **112.5 total hours**

2030 AGENDA GOALS

PROFESSORS

FERNANDEZ ARROIABE TXAPARTEGI, PERU
BERASATEGUI AROSTEGUI, JOANES

REQUIRED PREVIOUS KNOWLEDGE

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

LEARNING RESULTS

LEARNING RESULTS	KC	SK	AB	ECTS
MS031 - Analyse the different heat transfer mechanisms in energy systems on the basis of numerical and analytical methods	x			1,92
MS032 - Sizes and designs optimal fluid/thermal components for cooling of storage systems and electric drives		x		2,24
MS171 - Ability to work in multidisciplinary teams and in a multilingual environment	x		x	0,08
MS222 - Exhibits, argues and defends the results obtained in the work carried out before a panel of judges			x	0,06
MS251 - Develops a project in the field of energy systems in a practical application context		x		0,2
			Total:	**4,5**

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

SECONDARY LEARNING RESULTS

RMS222 **[!]** ***Expone, argumenta y defiende ante un tribunal los resultados obtenidos en el trabajo desarrollado***

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		1,5 h.	1,5 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

(No mechanisms)

CH - Class hours: 0 h.
NCH - Non-class hours: 1,5 h.
TH - Total hours: 1,5 h.

RMS106 **[!]** ***Dimensionar y diseñar los componentes fluido/térmicos óptimos para la refrigeración de sistemas de almacenamiento y accionamientos eléctricos***

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		11 h.	11 h.
Personal study and flexible development of concepts and subjects using active dynamics, to		3 h.	3 h.

foster more meaningful learning			
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	2 h.		2 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	26 h.		26 h.
Carrying out exercises and solving problems individually and/or in teams	6 h.	8 h.	14 h.

EVALUATION SYSTEM	W
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	17%
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	33%
Individual written and/or oral tests or individual coding/programming tests	50%

MAKE-UP MECHANISMS

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

Comments: To calculate the final exam grade, it will be averaged with the failed exam: 75%-25%.

CH - Class hours: 34 h.
NCH - Non-class hours: 22 h.
TH - Total hours: 56 h.

RMS251 **[!]** ***Desarrolla un proyecto del ámbito de los sistemas energéticos en un contexto de aplicación práctica***

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		5 h.	5 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

(No mechanisms)

CH - Class hours: 0 h.
NCH - Non-class hours: 5 h.
TH - Total hours: 5 h.

RMS171 **[!]** ***Es capaz de trabajar en equipos multidisciplinares y en un entorno multilingüe***

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		2 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	100%

MAKE-UP MECHANISMS

(No mechanisms)

CH - Class hours: 0 h.
NCH - Non-class hours: 2 h.
TH - Total hours: 2 h.

RMS105 **[!]** ***Analizar los distintos mecanismos de transferencia de calor en sistemas de energía en base a métodos numéricos y analíticos***

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		10 h.	10 h.
Personal study and flexible development of concepts and subjects using active dynamics, to foster more meaningful learning		2 h.	2 h.
Conducting tests, giving presentations, presenting defences, taking examinations and/or doing checkpoints	1 h.		1 h.
Presentation by the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	18 h.		18 h.
Carrying out exercises and solving problems individually and/or in teams	10 h.	7 h.	17 h.

EVALUATION SYSTEM	W
Reports on the completion of exercises, case studies, computer exercises, simulation exercises, laboratory exercises, term projects, challenges and problems	17%
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	33%
Individual written and/or oral tests or individual coding/programming tests	50%

MAKE-UP MECHANISMS

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

Comments: To calculate the final exam grade, it will be averaged with the failed exam: 75%-25%.

CH - Class hours: 29 h.
NCH - Non-class hours: 19 h.
TH - Total hours: 48 h.

CONTENTS

1. Fundamentals of heat transfer
    1. Heat transfer mechanisms.
    2. Conduction: lumped parameter method.
    3. Convection: heat transfer without/without phase change.
    4. Heat generation in electronic equipment
2. Cooling of storage systems, electric drives and electronic equipment.
    1. Cooling modes and architectures
    2. Auxiliary elements of cooling systems.
    3. Analysis and design of cooling envelopes and jackets.
3. Numerical fluid-thermal simulations
    1. CAD design tools
    2. CFD/CHT fluid-thermal simulation tools.
    3. 1D modelling of fluid-thermal systems.

LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources	Bibliography
Moodle Platform	Acceso online a bibliografía: https://labur.eus/DT2iI
Class presentations	
Specific Master Software	