PERSONA CIÈNCIA EMPRESA
Universitat Ramon Llull

TITLE OF COURSE:
THERMOTECHNICS

MATTER: Energetic Technology **MODULE**: Specific Technology **PROGRAM TITLE**: Degree on Industrial Technologies Enginnering

GENERAL CHARACTERISTICS*

Type: ☐ Basic training, ☑ Compulsory elective, ☐ Optional
☐ Final degree project, ☐ Practicum

Duration: Semiannual **Semester/s**: 6
Number of credits ECTS: 5
Language/s: Spanish, Catalan, English

DESCRIPTION

BRIEF DESCRIPTION AND JUSTIFICATION (the meaning of the course in relation to the studies. Between 100 and 200 words.)

The heat transfer is the transmission power due to a temperature difference. This science focuses his study in determining the manner and rate at which energy is exchanged.

The course aims to meet the Heat Transfer and its mechanisms-conduction, convection and radiation. We studied the stable state and not stable with and without generation of thermal energy.

And solve problems arising Heat Transfer by using algebraic methods and other methods are mathematically more complex influencing their knowledge, application and usage.

Knowledge is applied in the design of industrial equipment.

COMPETENCES (of the course made in relation to preassigned competences in this area.)

• Knowledge of materials science and technology to enable them to learn new methods and theories, and to equip them with the versatility to adapt to new situations. (E3)
• Ability to solve problems with initiative, decision making, creativity and critical thinking. (E4)
• Applied knowledge on renewable energy. (TE3)
• Applied knowledge of thermal engineering. (TE7)

PREREQUISITES* (modules, matters, courses and knowledge needed to follow the course. Can be stated that courses must have been completed.)
Have completed the basic training module.

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CONTENTS

1. Introduction to Heat Transfer.
   - Overview of the mechanisms of conduction, convection and radiation.
   - Energy balance.
2. Driving mechanism.
   - Driving. Fourier Act.
   - Thermal conductivity.
   - Equation of heat diffusion.
   - steady-dimensional conduction.
3. Mechanism convection
   - Boundary layer hydrodynamics. Thermal boundary layer. Laminar and turbulent flow.
   - basic equation for the analysis of heat transfer through convection.
   - free or natural convection. Correlations.
   - Forced convection in external flow. Correlations.
   - Forced convection in internal flow. Correlations.
   - Condensation and Boiling.
   - Overall coefficient of heat transfer.
   - critical radius of insulation.
4. Radiation mechanism.
   - black body radiation.
   - Absorptivity, emissivity, surface reflectivity.
   - KCL. Gray surfaces.
   - radiative exchange between surfaces.
   - Form factor of radiation. Relationship between form factors.
   - radiation exchange between black surfaces.
   - radiation exchange between diffuse gray surfaces.
5. Extended surfaces. Fins.
   - Equation fin.
   - Effectiveness of the fin.
   - efficiency of the fin.
   - fin array.
6. Steady two-dimensional conduction.
   - Form Factor conductive.
   - Method of Finite Differences.
7. Driving transient.
   - Method lumped.
   - Plane wall with convection.
   - Radial Systems with Convection.
   - semi-infinite solid.
   - multidimensional effects.
   - Method of finite differences.
8. Equipment for heat transfer.
   - Design and analysis of heat exchangers.
9. Industrial heat generation: renewable energies.

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METHODOLOGY

TRAINNING ACTIVITIES* (Complete the table relating activities, workload in ECTS credits, and competences.)

Training activities	ECTS Credits	Competences
Sessions presentation of concepts (A1)	1,60	E3, TE3
Sessions for resolution of exercises, problems and cases (A2)	0,50	E4, TE7
Practical work / laboratory (A5)	0,60	TE3, TE7
Personal study activities by students (A7)	2,10	E3, E4, TE3, TE7
Evaluation activities (exams, tests,…) (A8)	0,20	E3, E4, TE3, TE7
TOTAL	**5**	

EXPLANATION OF THE TEACHING METHODOLOGY (justifying the teaching methods used in relation to the competences and course contents. Between 100 and 200 words.)

The teaching methods of the course is based on combining a dynamic exhibition (presentation of content) with a dynamic demonstration (teacher shows how to solve problems), followed by an active dynamic (the student solves problems the teacher corrects a posteriori). This encourages active student participation and facilitates the acquisition of knowledge and practice in problem solving.

The teaching methods of the course is based on the availability of laptops by students. For the student's personal study documents are supplied for the sessions, collections and library resources problems.

EVALUATION

EVALUATION METHODS* (Fill in the table relating evaluation methods, competences and weight in the qualification of the subject.)

Evaluation Methods	Weight	Competences
Final Exam (A)	40%	E3, E4, TE7, TE3
Examination / s Partial / s / control / s scheduled / s (B)	35%	E4, TE7
Laboratory reports (H)	15%	E3, TE7
Practical work / lab (I)	5%	E3, TE7
Participations (K)	5%	E4

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LEARNING OUTCOMES (Explanation of the achievements of students that allow competences evaluation, relating to competences and evaluation methods.)

• The student must demonstrate knowledge of heat transport and renewable energy (E3, TE3) [Final Exam (A)].
• The student must demonstrate proficiency in identifying, formulating and solving problems in the field of heat transport (E4, TE7) [Final Exam (A), midterms / programmed controls (B)].
• The student must demonstrate ability to use systems, components or processes to achieve the requirements of the task to perform (E3, E4, TE7) [Lab Reports (H), practical / laboratory (I), Participation (K)].

QUALIFICATION (Explanation of the calculation system of qualifying the course.)

The final grade for the course will consider the marks obtained by the student in the final examination (A), midterms / programmed controls (B), lab reports (H), practical / laboratory (I) and Participation (K).

All ratings are expressed on a scale of 0 to 10.

The Final Exam (A) consist of two parts: 30% of knowledge assessment and 70% of problem solving.

Midterms / programmed controls (B) consist of exercises on the subject studied in the measured resolution of a problem, will take place at the scheduled time and classroom teaching of the subject. The rating of midterms / programmed controls (B) is the arithmetic mean of all changes.

Laboratory Reports (H) and practical work / lab (I) assess the information provided by the professor in charge of the Laboratory, applying the mean in each of the assessment procedures.

Participation (K) will be evaluated by monitoring student attendance at scheduled times of the subject. The maximum score (10 points) is obtained by attending all. Exceed the value of 25% of scheduled hours of the course which will not lose attended the school for the course and must re-register.

The final grade for the course in all the official announcements of the course will be calculated: 0.40 A + 0.35 B + 0.15 H + 0.05 I + 0.05 K

EVALUATION OF COMPETENCES (Defining expressions of calculation for each competence based on corresponding evaluations activities.)

The skills assessment is obtained:

E3, E4, TE3: is the final exam grade (A)
TE7: is the arithmetic average rating of Final Exam (A) and Final Exams / programmed controls (B).

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TEXTBOOKS (recommended and accessible to students.)

- F. P. Inkropera, D. P. DeWitt, T.L. Bergman y A. S. Lavine, *Introduction to Heat Transfer*, John Wiley & Sons, 5ª ed., New Jersey 2007.
- D. W. Green y R. H. Perry, *Chemical Engineers' Handbook*, 8ª ed., McGraw-Hill, New York 2007.
- Publicaciones CENER, Centro Nacional de Energías Renovables (www.cener.com), http://www.cener.com/es/libros/index.asp
- Publicaciones IDAE, Instituto para la Diversificación y Ahorro de la Energía (www.idae.es), http://idae.electura.es

HISTORICAL DOCUMENT

EARLIER CHANGES

February 26, 2012. María Luisa Espasa
July 19, 2012. María Luisa Espasa

LAST REVISION

May 8, 2015. María Luisa Espasa

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