Course guide
340038 - FENT-F3O29 - Fundamentals of Termical Engineering

Last modified: 03/04/2024

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 729 - MF - Department of Fluid Mechanics.

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: JAUME MIQUEL MASALLES

Others: JAUME MIQUEL MASALLES
DAVID MORENO MAESTRO
GEMMA CANTÓ ATIENZA

PRIOR SKILLS

Previous knowledge of basic thermodynamics and heat transfer.
Basic previous knowledge of the behavior of fluids.
Integral and differential calculus.

REQUIREMENTS

340022 - Chemistry
340023 - Physics I
340026 - Advanced calculus

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE7. Knowledge of applied thermodynamics and heat transfer. Basic principles and its application in solving engineering problems.

Transversal:
3. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
4. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
5. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

TEACHING METHODOLOGY

- Lectures and participatory classes, consisting of explanation and development of the theory and, if necessary in the resolution of problems. The material user will be available to the student in the Digital Campus section of the subject.

- Practical lessons in problem-solving, where it will seek the maximum involvement of students through their direct involvement in solving the problemes. Students must solve in class / outside of class individually problems that are assigned. In the Digital Campus section of the subject, the student can look up the list of problems before they are done in class.

- Hand in resolved problems by students. Submittals will consist on individual, in class or outside class, of some problems of the list or similar, the student will have in the Digital Campus. This activity will be evaluated. The student feed-back can made from the submission of the revised problems.

- Laboratory and simulation practical classes, made directly by students, guided by the teacher, allowing them to directly observe relevant aspects of the theory. The student can look up the explanatory text of the practices to develop in the Digital Campus. The students will give the theacher a copy of the experimental extracted data. Later, students must make a report of the practices carried out. This report will be evaluated and will be delivered before the date set by the theacher.

- Tutorial classes in group or individual.

- INDIVIDUAL WRITTEN TESTS: The students will make two partial exams (individual written tests) of all the knowledge of theory and problems developed in the subject. In the first partial exam (CP1), the knowledge evaluated will be those developed in the first part of the semester, and will be done towards the middle of the semester. In the second partial (CP2) the knowledge developed in the second part of the semester will be evaluated, and it will be done at the end of the semester on the date marked by the EPSEVG (Final Evaluation period). There will be a Final Control of the subject (CFinal) in the Final Evaluation period. Students with grade of CP1 less than 3.50 can be presented in an optional way to this Final Control, which will replace Partial Control 2 (CP2). There will also be a Global Control (CGlobal) of Reevaluation of all knowledge of theory and problems developed in the subject on the date marked by the EPSEVG (Reevaluation period).

LEARNING OBJECTIVES OF THE SUBJECT

When the student finishes the subject, he/she has to be capable of:
· Understanding the principles of applied thermodynamics and heat transfer.
· Knowing the principles of thermal equipment and generators.
· Analyzing and solving problems in the area of thermal engineering.
· Interpreting, analyzing, synthesizing and extracting conclusions of results of measurements and tests.
· Writing texts with the structure adapted to the aims of communication.
· Knowing and putting into practice the dynamics teamwork.
· Carrying out assignments from basic directions given by the teacher.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours small group	7,5	5.00
Hours large group	52,5	35.00

Total learning time: 150 h

CONTENTS

TOPIC 1: FUNDAMENTAL CONCEPTS OF THERMODYNAMICS. PROPERTIES OF PURE SUBSTANCES

Description:
1.1. Concept of thermodynamic system. Classification and examples

Specific objectives:
At the end of this teaching unit, the student must be able to:

Related activities:
A1. Problems of properties of pure substances and equations of state.
A6. First individual written test.
A7. Computer practice: Calculation of volumetric properties of pure fluids with cubic equations of state and comparison with MINIREF software.

Full-or-part-time: 32h
Theory classes: 12h
Laboratory classes: 2h
Self study : 18h

TOPIC 2: FIRST AND SECOND PRINCIPLES OF THERMODYNAMICS

Description:
2.1. Work of volume change in a reversible process in a closed system.

Specific objectives:
At the end of this teaching unit, the student must be able to:

Related activities:
A.2. Problems of the first and second principles of thermodynamics.
A.6. Second individual written test.

Full-or-part-time: 32h
Theory classes: 12h
Self study : 20h

TOPIC 3: PRINCIPLES OF HEAT TRANSMISSION. APPLICATIONS.

Description:
3.1 Introduction to heat transfer mechanisms.

Specific objectives:
At the end of this teaching unit, the student must be able to:

Related activities:
A3. Problems of heat transfer principles.
A8. Laboratory: Determination of thermal conductivity of an insulating material.
A11. Second individual written test.

Full-or-part-time: 28h
Theory classes: 10h
Laboratory classes: 1h
Self study : 17h

TOPIC 4: FUNDAMENTALS OF TECHNICAL THERMODYNAMICS

Description:
4.1. Steam power plants cycles: Rankine cycle. Irreversibilities. Superheat and reheat. Regenerative power cycle.

Specific objectives:
At the end of this teaching unit, the student must be able to:

Related activities:
A4. Problems of fundamentals of Technical Thermodynamics.
A9. Laboratory: Determination of the heat balance and the COP of a heat pump as a function of time.
A10. Computer practice: Analysis of the operation of a conventional power plant with the "PROPAGUA" software.
A11. Second individual written test

Full-or-part-time: 32h
Theory classes: 10h
Laboratory classes: 3h
Self study : 19h

TOPIC 5: INTRODUCTION TO THERMAL EQUIPMENT AND GENERATORS

Description:
5.1. Heat exchangers: Classification. Overall heat transfer coefficient (U). Energy balance equations. Logarithmic mean temperature difference (LMTD). F graphs for different types of heat exchangers. Calculation Method F-LMTD.
5.2. Fuels and combustion: Classification of fuels. Calorific value of the fuel. Chemical equations of combustion (stoichiometric combustion, combustion with air excess and defect).
5.3. Boilers or steam generators: Classification. Use of the boilers. Mass and energy balance applied to a boiler. Efficiency of a boiler.

Specific objectives:
At the end of this teaching unit, the student must be able to:

Related activities:
A5. Problems of introduction to equipment and thermal generators.
A11. Second individual written test.

Full-or-part-time: 26h
Theory classes: 10h
Self study : 16h

GRADING SYSTEM

The different concepts that make up the continuous assessment are:
- INDIVIDUAL WRITING TESTS: 77%
- DELIVERY OF SOLVED PROBLEMS: 10%
- PRACTICES (LABORATORY AND SIMULATION): 13%

To obtain the final grade of FENT, the following equation of the evaluation will be applied:

[1] Final Note from FENT = Note CP1*0.385 + Note CP2*0.385 + Note Delivery Problems*0.10 + Practice Note*0.13

Students who have obtained a grade equal to or greater than 3.5 in the Note of CP1, will necessarily have to do the CP2. Students who have obtained a grade lower than 3.5 in the Note of CP1, may be presented as an optional to a Final Control (CFinal) instead of CP2. This CFinal will be held on the same day and time as the CP2, within the Final Evaluation Period. The equation of the evaluation, to obtain the final grade of FENT, in this case is:

[2] Final Note from FENT = Note CFinal*0.77 + Note Delivery of Problems*0.10 + Practice Note*0.13

There are no minimum scores in any of the previous evaluative acts at the time of applying equations [1] or [2].

RE-EVALUATION:
The student who is suspended and has a Final Note from FENT between 2.0 and 4.9 , has the right to appear for the Re-evaluation of the FENT subject.
The re-evaluation will consist of a Global Control of theory and problems of the subject that will weigh 77%.
Once the Global Control (CGlobal) of re-evaluation is done, the final grade of Re-evaluation will be obtained from the following expression:

Final Note Re-evaluation = Note CGlobal*0.77 + Note Problem Delivery*0.10 + Practice Note*0.13

The Final Note from FENT after the re-evaluation will be:
a) If the "Final Note Re-evaluation" is higher than 7.0: Final Note from FENT = 7.0
b) If the "Final Note Re-evaluation" is between 5.0 and 7.0: Final Note from FENT = Final Note Re-evaluation.
c) If the "Final Note Re-evaluation" is less than 5.0: The highest grade between the Final Note Re-evaluation and the Final Note from FENT prior to the re-evaluation will be taken as the Final Note from FENT.

EXAMINATION RULES.

- Each of the two individual written exams (Partial Controls) consist of two parts: a theory test (which may constitute up to 30% of the test score) and a certain number of problems (up to 100% completion of the test grade). Both tests have the same evaluative weight (38.5%). A minimum grade of the partial controls is not required.

- The Final Control (CFinal) will consist of two parts: a theory test (which may constitute up to 30% of the test score) and a certain number of problems (up to completing 100% of the test grade)). This test has an evaluative weight of 77%. A minimum grade of the Final Control is not required.

- Deliveries of the resolution of practical problems solved individually will be evaluated following the rubric for the realization of the delivery of resolution of problems, which the student will have in advance. The problems solved must be delivered personally to the teacher or through the Campus Athena, and within the allotted time period.

- The reports of laboratory practices will be evaluated according to the rubric established for the realization of them and that the students will have previously. To have a note of the laboratory practices, it is essential to have done the practices in person and present the corresponding reports with the group with which the laboratory practice was carried out.

- If a student presents deliveries of problems and / or practices, at the end he / she will have a grade of the subject even if he / she has not been submitted to the individual written tests (partial controls or final control).

RE-EVALUATION:

- When the Final Score of FENT is lower than 5.0 but equal to or higher than 2.0, you can opt for the Reevaluation. In this case, the theory and problems contents of CP1 and CP2 are reappraised. In the Reevaluation there will be a Global Control of the subject (CGlobal) and this will have a weight of 77%.

- The Global Control (CGlobal) of the re-evaluation will consist of two parts: a theory test (which may constitute up to 30% of the test score) and a certain number of problems (up to 100% of the grade of the test).

BIBLIOGRAPHY

Basic:
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- Moran, Michael J.; Shapiro, Howard N. Principles of engineering thermodynamics. 8th ed. Hoboken, N.J: John Wiley & Sons, 2015. ISBN 9781118412930.
- Çengel, Yunus A.; Ghajar, Afshin J. Transferencia de calor y masa : fundamentos y aplicaciones [on line]. 6a ed. México, Madrid: McGraw-Hill, 2020 [Consultation: 15/02/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=10213. ISBN 9781456277215.
- Llorens, Martín; Miranda Barreras, Ángel Luis. Ingeniería térmica. Barcelona: Marcombo, 2009. ISBN 9788426715319.

Complementary:
- Çengel, Yunus A.; Cimbala, John ; Ghajar, Afshin J. Fundamentals of thermal-fluid sciences. 6th ed. New York: McGraw-Hill, 2022. ISBN 9781260597585.
- Kaminski, Deborah A.; Jensen, Michael K. Introduction to thermal and fluids engineering. New York: John Wiley & Sons, 2005. ISBN 0471268739.
- Dutta, Binay K.. Heat transfer: principles and applications. New Delhi: PHI Learning, 2006. ISBN 9788120316256.
- Chandra, Ramesh. Refrigeration and air conditioning. New Delhi: PHI Learning, 2010. ISBN 9788120339156.

RESOURCES

Other resources:

In computer classrooms of EPSEVG, the computer programs (software) used in the course of FENT are installed.