Course guide
220062 - AMO - Application of Matlab-Octave to Thermal Engineering Problems

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 724 - MMT - Department of Heat Engines.
Degree: BACHELOR’S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR’S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR’S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).
Academic year: 2023 ECTS Credits: 3.0 Languages: English

LECTURER
Coordinating lecturer: Rigola Serrano, Joaquim
Others: Oliet Casasayas, Carles
Calventus Sole, Yolanda

PRIOR SKILLS
Nothing special

REQUIREMENTS
Laptop computer

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES
Specific:
1. An understanding of, and skills for, the modelling and simulation of systems
2. An understanding of applied thermodynamics and heat transfer: basic principles and their application to solving engineering problems
3. An understanding of the fundamentals and applications of digital electronics and microprocessors
4. Applied knowledge of thermal engineering
5. The ability to solve mathematical problems that may arise in an engineering context. The ability to apply knowledge of linear algebra; geometry; differential geometry; differential and integral calculus; differential and partial differential equations; numerical methods; numerical algorithms; statistics and optimisation
6. Understanding and mastery of basic concepts about the general laws of mechanics, thermodynamics and electromagnetism fields and waves and their application to solving problems in engineering.

Transversal:
7. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
8. 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

The course is divided into parts:
- Theory classes
- Practical classes
- Self-study for doing exercises and activities.

In the theory classes, teachers will introduce the theoretical basis of the concepts, methods and results and illustrate them with examples appropriate to facilitate their understanding.

In the practical classes (in the classroom), teachers guide students in applying theoretical concepts to solve problems, always using critical reasoning. We propose that students solve exercises in and outside the classroom, to promote contact and use the basic tools needed to solve problems.

Students, independently, need to work on the materials provided by teachers and the outcomes of the sessions of exercises/problems, in order to fix and assimilate the concepts.

The teachers provide the curriculum and monitoring of activities (by ATENEA).

LEARNING OBJECTIVES OF THE SUBJECT

Learn how to implement a thermodynamic model of a power cycle with Matlab-Octave
Learn how to open and process files with experimental data with Matlab-Octave
Learn how to write Matlab-Octave code for embedded systems to measure thermodynamic properties
Learn how to solve chemical equilibrium problems with Matlab-Octave
Learn how to solve ordinary differential equations with Matlab-Octave

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>45.0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30.0</td>
<td>40.00</td>
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</tbody>
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Total learning time: 75 h

CONTENTS

Module 1: Practical introduction to Matlab & Octave

Description:
The use of Matlab-Octave will be explained

Related activities:
Exercise 1

Full-or-part-time: 18h
- Theory classes: 5h
- Self study: 13h
Module 2: Power cycles

Description:
The main thermodynamic power cycles (Rankine, Brayton, Otto, Diesel) will be reviewed. An example will be implemented during the class. The cycles will be optimized using conventional methods and a open-source Matlab code.

Related activities:
Exercise 2

Full-or-part-time: 22h
Theory classes: 10h
Self study : 12h

Module 3: Acquisition and processing of experimental data with Matlab

Description:
Using an actual data file, the opening and processing of experimental data files with Matlab-Octave will be described. The use of a low-cost Raspberry-pi micro computer to run Octave will be explained in practice.

Related activities:
Exercise 2

Full-or-part-time: 20h
Theory classes: 10h
Self study : 10h

Module 4: Gas combustion problems

Description:
Thermodynamic properties of ideal gas mixtures
Chemical equilibrium as a Gibbs energy minimization problem
Matlab calculation of gas flame temperature and product composition

Related activities:
Exercise 2

Full-or-part-time: 15h
Theory classes: 5h
Self study : 10h

GRADING SYSTEM

The final grade depends on the following assessment criteria:

- Practical exercise 1: Modeling and Implementation of thermodynamic models in cycles. 50%
- Practical exercise 2: Different exercises to be chosen by the students within thermal problems. 50%
BIBLIOGRAPHY

Basic: