220062 - Application of Matlab-Octave to Thermal Engineering Problems

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 724 - MMT - Department of Heat Engines

Academic year: 2019

Degree: BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)

ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: Rigola Serrano, Joaquim

Others: Ventosa Molina, Jordi
Pedro Costa, Juan Bautista
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

Total learning time: 75h	Hours large group:	30h	40.00%
	Self study:	45h	60.00%

Content

Module 1: Practical introduction to Matlab ¿ Octave	Learning time: 18h Theory classes: 5h Self study : 13h

Description:
The use of Matlab-Octave will be explained

Related activities:
Exercise 1

Module 2: Power cycles	Learning time: 22h Theory classes: 10h Self study : 12h

Description:
The main thermodynamic power cycles (Rankine, Brayton, Otto, Diesel) will be reviwed
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

Module 3: Acquisition and processing of experimental data with Matlab	Learning time: 20h Theory classes: 10h Self study : 10h

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

Module 4: Gas combustion problems	Learning time: 15h Theory classes: 5h Self study : 10h

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

Qualification system

The final grade depends on the following assessment criteria:

- Practical exercise 1: Implementation of a thermodynamic model of a power cycle. 50%
- Practical exercise 2: Exercise to be chosen by the students. 50 %
-
The students will select one of the following exercises:
-Implementation of a combustion thermodynamic model
-Design of the software and display for an embedded throttling calorimeter with Raspberry Pi
-ODE modelling of a thermal system with Matlab

Bibliography

Basic:

Palm, William J. Introduction to MATLAB for engineers. 3rd ed. Dubuque, IA: McGraw-Hill, 2012. ISBN 9781259012051.

Eaton, J.W.; Bateman, D.; Handberg, S. GNU octave version 3.0.1 manual. 3rd ed. Createspace, 2009. ISBN 9781441413000.

Horan, Brendan. Practical Raspberry Pi [on line]. Nova York: Apress, 2013 [Consultation: 08/05/2018]. Available on: <http://site.ebrary.com/lib/upcatalunya/detail.action?docID=10718888>. ISBN 9781430249719.

McManus, S.; Cook, M. Raspberry Pi for dummies [on line]. Hoboken: John Wiley & Sons, 2013 [Consultation: 21/05/2014]. Available on: <http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10674848&p00=9781118554227>. ISBN 9781118554210.