

## Course guide

# 220062 - AMO - Application of Matlab-Octave to Thermal Engineering Problems

**Last modified:** 19/04/2023

**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

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**Coordinating lecturer:** Rigola Serrano, Joaquim

**Others:** Oliet Casasayas, Carles  
Calventus Sole, Yolanda

### PRIOR SKILLS

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Nothing special

### REQUIREMENTS

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Laptop computer

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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#### 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

Type	Hours	Percentage
Self study	45,0	60.00
Hours large group	30,0	40.00

**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

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### 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: for Octave version 3.0.1. 3rd ed. Boston: Soho books, 2007. ISBN 9781441413000.
- Horan, Brendan. Practical Raspberry Pi [on line]. Nova York: Apress, 2013 [Consultation: 26/09/2022]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=1317333>. ISBN 9781118554227.
- McManus, S.; Cook, M. Raspberry Pi for dummies [on line]. Hoboken: John Wiley & Sons, 2013 [Consultation: 26/09/2022]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=1154402>. ISBN 9781118554210.