# Syllabus

## Course description

<table>
<thead>
<tr>
<th>Course title</th>
<th>Engineering Thermodynamics and Heat Transfer for Mechatronics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course code</td>
<td>42186</td>
</tr>
<tr>
<td>Scientific sector</td>
<td>ING-IND/11</td>
</tr>
<tr>
<td>Degree</td>
<td>Ingegneria Industriale Meccanica</td>
</tr>
<tr>
<td>Semester</td>
<td>2</td>
</tr>
<tr>
<td>Year</td>
<td>2</td>
</tr>
<tr>
<td>Academic Year</td>
<td>2021-22</td>
</tr>
<tr>
<td>Credits</td>
<td>6</td>
</tr>
<tr>
<td>Modular</td>
<td>no</td>
</tr>
<tr>
<td>Total lecturing hours</td>
<td>36</td>
</tr>
<tr>
<td>Total lab hours</td>
<td>0</td>
</tr>
<tr>
<td>Total exercise hours</td>
<td>24</td>
</tr>
<tr>
<td>Attendance</td>
<td>Not mandatory</td>
</tr>
<tr>
<td>Prerequisites</td>
<td></td>
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<td>Course page</td>
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</table>

### Specific educational objectives

During the course, the issues related to heat transfer will be presented and analyzed and in particular: Analytical models of heat transmission in its forms like:

- first law of thermodynamics
- mechanisms of heat transfer
- conduction
- convection
- irradiance
- Initial and boundary conditions
- steady state heat transfer
- heat exchangers
- second law of thermodynamics
- acoustics: principles and applications

#### Lecturer

Dr. Marco Caniato

Scientific sector of the lecturer

ING-IND/11

Teaching language

English

Office hours

Appointment by email

Teaching assistant (if any)

18

List of topics covered

- FUNDAMENTALS OF THERMODYNAMICS
- Units of measure and fundamentals of Thermometry.
- First Law of Thermodynamics
- Application Areas of Heat Transfer
- Modeling in Heat Transfer
- Specific Heats of Gases, Liquids, and Solids
- Energy Transfer
HEAT TRANSFER
Heat transfer mechanisms. Thermal heat conduction in monodimensional systems in steady state.
Thermal Conductivity
Thermal Diffusivity
Thermal heat convection and dimensional analysis.
Boundary and Initial Conditions
Thermal Contact Resistance
Global heat transfer and heat exchangers. Thermal radiation.
Numerical models for heat transfer
Second law of thermodynamics
Wave propagations in solids and fluids
Psychoacoustics
Sound pressure level and Sound Power level
Sound Intensity
Sound absorption and sound Insulation
The measures in acoustics

Teaching format
Class lectures (Videos and slides)
exercises using spreadsheets and numerical simulations
Lecture material (slides and videos) will be available for download by the students.

Learning outcomes (ILOs)
The learning outcomes need to refer to the Dublin Descriptors:

(1) Knowledge and understanding
- energy balance terms
- heat transfer mechanism influences and different efforts on dissipations
- heat transfer behaviors
- heat exchangers functions and design
- Acoustics and sound wave propagation

(2) Applying knowledge and understanding
- the ability to solve the main heat transfer models applied to the different heat transfer behaviors
- the ability to apply basic heat transfer mechanism to the design of simple heat exchangers
- The ability to apply and solve simple problems in acoustics

(3) Making judgements
The student will be able to understand and compare and then choose the appropriate heat transfer behaviour in relation to a simple final application and sizing also using numerical simulations

(4) Communication skills
- Using the appropriate technical vocabulary related to
Preparing a report representing and summarizing complex results and providing appropriate interpretation.

(5) Ability to learn
- Lifelong learning capability through the acquisition of critical tools and critical evaluation of product and systems specifications
- Finding the analytical expression and the correct numerical solution, comparing different methodologies and sources

**Assessment**

**Formative assessment**

<table>
<thead>
<tr>
<th>Form</th>
<th>Length /duration</th>
<th>ILOs assessed</th>
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</thead>
<tbody>
<tr>
<td>Development of the assigned design work</td>
<td>During the course</td>
<td>(2), (3), (5)</td>
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**Summative assessment**

<table>
<thead>
<tr>
<th>Form</th>
<th>%</th>
<th>Length /duration</th>
<th>ILOs assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>In class (or office hours) exercises and discussion</td>
<td>100</td>
<td>20 hours (average for 30 minutes per exercise or oral discussion)</td>
<td>(1) (2), (3), (4), (5)</td>
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</table>

**Assessment language**

English

**Evaluation criteria and criteria for awarding marks**

To the admission to the second part, the first one has to be successfully passed.

The first part (numerical exercise) consists of numerical questions. The answer is correct when the result provided falls within a given tolerance with respect to the reference value. The evaluation is based on the accuracy of the numerical result of each question. The minimum mark is 12 out of 30 suitable to pass to the second part.

The score of this part contributes for 1/2 to the final mark.

In the second part, each question concerns a different section of the program.

They equally contribute to the final mark.

The evaluation is based on the completeness of the answer in terms of 1) definition of the subject 2) analytical description 3) graphical and mathematical representations 4) proof (if required)
The score of this second part contributes for 1/2 of the final mark.

**Required readings**
Teaching material, handouts, videos provided by the teacher

**Supplementary readings**
T.L. Bergman, A.S. Lavine, Fundamentals of heat and mass transfer, Wiley and Sons