

## COURSE OUTLINE

### 1. GENERAL

<b>SCHOOL</b>	SCHOOL OF ENGINEERING		
<b>DEPARTMENT</b>	ENVIRONMENTAL ENGINEERING		
<b>LEVEL OF STUDIES</b>	3 <sup>RD</sup>		
<b>COURSE CODE</b>	Δ2ΥΠ	<b>SEMESTER</b>	WINTER
<b>COURSE TITLE</b>	Applied Thermodynamics		
<b>TEACHING ACTIVITIES</b> <i>If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.</i>	<b>TEACHING HOURS PER WEEK</b>	<b>ECTS CREDITS</b>	
	6	5	
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
<b>COURSE TYPE</b> <i>Background, General Knowledge, Scientific Area, Skill Development</i>	Background		
<b>PREREQUISITES:</b>			
<b>TEACHING &amp; EXAMINATION LANGUAGE:</b>	Greek, English		
<b>COURSE OFFERED TO ERASMUS STUDENTS:</b>	YES		
<b>COURSE URL:</b>	<a href="https://eclass.duth.gr/courses/TMC232/">https://eclass.duth.gr/courses/TMC232/</a>		

### 2. LEARNING OUTCOMES

<p><b>Learning Outcomes</b> <i>Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.</i></p> <p>The course's aim is to introduce students to the fundamental principles and calculations thermodynamics and control, and to comprehend:</p> <ul style="list-style-type: none"> <li>• the thermodynamic properties of gasses, liquids and solids</li> <li>• the internal energy and the enthalpy of pure substances</li> <li>• the 1<sup>st</sup> and the 2<sup>nd</sup> law of thermodynamics</li> <li>• the operation of thermal engines and cooling cycles</li> <li>• the thermodynamics of chemical reactions</li> </ul>																		
<p><b>General Skills</b> <i>Name the desirable general skills upon successful completion of the module</i></p> <table border="0"> <tr> <td><i>Search, analysis and synthesis of data and information,</i></td> <td><i>Project design and management</i></td> </tr> <tr> <td><i>ICT Use</i></td> <td><i>Equity and Inclusion</i></td> </tr> <tr> <td><i>Adaptation to new situations</i></td> <td><i>Respect for the natural environment</i></td> </tr> <tr> <td><i>Decision making</i></td> <td><i>Sustainability</i></td> </tr> <tr> <td><i>Autonomous work</i></td> <td><i>Demonstration of social, professional and moral responsibility and sensitivity to gender issues</i></td> </tr> <tr> <td><i>Teamwork</i></td> <td><i>Critical thinking</i></td> </tr> <tr> <td><i>Working in an international environment</i></td> <td><i>Promoting free, creative and inductive reasoning</i></td> </tr> <tr> <td><i>Working in an interdisciplinary environment</i></td> <td></td> </tr> <tr> <td><i>Production of new research ideas</i></td> <td></td> </tr> </table> <p>Autonomous work.</p>	<i>Search, analysis and synthesis of data and information,</i>	<i>Project design and management</i>	<i>ICT Use</i>	<i>Equity and Inclusion</i>	<i>Adaptation to new situations</i>	<i>Respect for the natural environment</i>	<i>Decision making</i>	<i>Sustainability</i>	<i>Autonomous work</i>	<i>Demonstration of social, professional and moral responsibility and sensitivity to gender issues</i>	<i>Teamwork</i>	<i>Critical thinking</i>	<i>Working in an international environment</i>	<i>Promoting free, creative and inductive reasoning</i>	<i>Working in an interdisciplinary environment</i>		<i>Production of new research ideas</i>	
<i>Search, analysis and synthesis of data and information,</i>	<i>Project design and management</i>																	
<i>ICT Use</i>	<i>Equity and Inclusion</i>																	
<i>Adaptation to new situations</i>	<i>Respect for the natural environment</i>																	
<i>Decision making</i>	<i>Sustainability</i>																	
<i>Autonomous work</i>	<i>Demonstration of social, professional and moral responsibility and sensitivity to gender issues</i>																	
<i>Teamwork</i>	<i>Critical thinking</i>																	
<i>Working in an international environment</i>	<i>Promoting free, creative and inductive reasoning</i>																	
<i>Working in an interdisciplinary environment</i>																		
<i>Production of new research ideas</i>																		

### 3. COURSE CONTENT

1. Properties of pure substances
2. 1<sup>st</sup> law of thermodynamics – closed and open systems
3. 2<sup>nd</sup> law of thermodynamics
4. Entropy and isentropic efficiency
5. Internal combustion engines
6. Ideal and non-isentropic as turbines
7. Ideal and non-isentropic Steam turbines
8. Ideal and non-isentropic cooling cycles
9. Thermodynamic properties of gas mixtures
10. Thermodynamics of chemical reactions

### 4. LEARNING & TEACHING METHODS - EVALUATION

<p align="center"><b>TEACHING METHOD</b></p> <p align="center"><i>Face to face, Distance learning, etc.</i></p>	Face to face																	
<p align="center"><b>USE OF INFORMATION &amp; COMMUNICATIONS TECHNOLOGY (ICT)</b></p> <p align="center"><i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i></p>	Calculation sheets and communication with students.																	
<p align="center"><b>TEACHING ORGANIZATION</b></p> <p><i>The ways and methods of teaching are described in detail.</i></p> <p><i>Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research &amp; analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.</i></p> <p><i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	<table border="1"> <thead> <tr> <th align="center"><i>Activity</i></th> <th align="center"><i>Workload/semester</i></th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td align="center">36</td> </tr> <tr> <td>Tutoring</td> <td align="center">36</td> </tr> <tr> <td>Exercises</td> <td align="center">78</td> </tr> <tr> <td>Total</td> <td align="center">150</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> </tbody> </table>	<i>Activity</i>	<i>Workload/semester</i>	Lectures	36	Tutoring	36	Exercises	78	Total	150							
<i>Activity</i>	<i>Workload/semester</i>																	
Lectures	36																	
Tutoring	36																	
Exercises	78																	
Total	150																	
<p align="center"><b>STUDENT EVALUATION</b></p> <p><i>Description of the evaluation process</i></p> <p><i>Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others</i></p> <p><i>Please indicate all relevant information about the course assessment and how students are informed</i></p>	Two written exams, in Greek or English, at the middle of the semester and at the end of it, on half of the course content each. Exams refer to problem solving.																	

### 5. SUGGESTED BIBLIOGRAPHY

1. Class material.
2. Thermodynamics An Engineering Approach By Cengel And Boles

## ANNEX OF THE COURSE OUTLINE

### Alternative ways of examining a course in emergency situations

<b>Teacher (full name):</b>	Costas Athanasiou
<b>Contact details:</b>	+30 25410 79 316 (+30 6937 657 128)
<b>Supervisors: (1)</b>	YES
<b>Evaluation methods: (2)</b>	On-line written exams.
<b>Implementation Instructions: (3)</b>	Ten versions of two problems are uploaded to e-class and the students have upload the solutions, still to e-class within a specific time. Students are monitored by camera, during the exams, through Microsoft Teams.

(1) Please write YES or NO

(2) Note down the evaluation methods used by the teacher, e.g.

- *written assignment* or/and exercises
- written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(3) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises**: the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and **any other necessary information**.

b) in case of **oral examination with distance learning methods**: the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.