# COURSE OUTLINE

## (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>ENGINEERING SCHOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPARTMENT</td>
<td>MECHANICAL ENGINEERING DEPARTMENT</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDER GRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>2703002</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>3th</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Metallic Materials Technology &amp; Quality Control</td>
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</tbody>
</table>

### INDEPENDENT TEACHING ACTIVITIES

*If credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits.*

<table>
<thead>
<tr>
<th>Activity</th>
<th>Weekly Teaching Hours</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Laboratory Exercises</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

*Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).*

### COURSE TYPE

- Special Background

### PREREQUISITE COURSES:

- 

### LANGUAGE OF INSTRUCTION and EXAMINATIONS:

- Greek (official)

### IS THE COURSE OFFERED TO ERASMUS STUDENTS

- YES (in English for ERASMUS students)

### COURSE WEBSITE (URL)

- Metallic Materials issues: [http://ikaros.teipir.gr/phyche/Labs/labChPetyl.htm](http://ikaros.teipir.gr/phyche/Labs/labChPetyl.htm)
(2) LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A
- Description of the level of learning outcomes on each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area
- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

Initially, the course is an introduction to the basic concepts in technology of metallic materials and their quality control. Subsequently, the course is focusing in specific concepts and techniques related to steels and their heat treatment. It is providing the background related to material science for the majority of the specialty courses.

The aim of the course is to deliver the necessary knowledge and skills to student in order to solve basic problems related to engineering materials.

Upon completion of the course, students will be able to:
1. Use and distinguish the concepts of (a) certification, (b) Standardization, (c) Accredited Laboratories and (d) Calibration
2. Identify and classify the main engineering materials based on their chemical composition and determine their mechanical properties.
3. Characterize the microstructure of metallic materials and to measure/compare/evaluate crucial mechanical properties, using standard methodologies.
4. Design and perform heat treatments of steels in order to improve their mechanical properties.
5. Evaluate the results of such heat treatments on the materials’ microstructure and mechanical properties and propose corrective actions, if necessary.
6. Select the appropriate tool steel and recommend the proper heat treatment sequence for specific targeted engineering applications.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

| Search for, analysis and synthesis of data and information, with the use of the necessary technology | Project planning and management |
| Decision-making | Respect for difference and multiculturalism |
| Working independently | Showing social, professional and ethical responsibility and sensitivity to gender issues |
| Team work | Criticism and self-criticism |
| Working in an international environment | Production of free, creative and inductive thinking |
| Working in an interdisciplinary environment | ...... |
| Production of new research ideas | Others... |

More specifically, students will be able to:
1. Search, analysis and synthesis of data/ information, using the necessary technology
2. Working independently
3. Decision-making
4. Autonomous work
5. Team work
6. Project planning and management
7. Criticism and self-criticism

(3) COURS CONTENT

Theory
### The core modules of the course include:

2. **Metallic materials:** properties of metals, free energy and Gibb’s law.
3. **Crystalline structure:** metallic bond, crystalline structure of metals, principal crystal structures, lattice systems. Atomic packing factor, d-spacing of lattice, atomic coordination.
4. **Crystalline structure imperfections:** point defects, line defects (dislocations), planar defects, bulk defects.
5. **Work hardening:** plastic deformation of metals, cold work hardening of metals, stress relieving.
6. **Alloy phase diagrams:** phases, lever rule.
7. **Fe-C phase diagram:** steels, binary phase diagram of steels, microstructure, microstructure transformations during heating and quenching. Steels’ heat treatment.
8. **Steel Hardening:** isothermal transformation (TTT diagrams), continuous cooling transformation (CCT diagrams), quantitative phase diagram of tool steels.
9. **Alloy elements:** alloy steels, effect of alloying elements on steels properties.
10. **Tool Steels’ technical brochures:** Standardization, applications, mechanical and physical properties, heat treatment and machining recommendations according to technical brochures provided by steel manufacturers.
11. **Fe-C phase diagram:** Cast irons, Fe-C (graphite) phase diagram. Phases of cast iron, cast irons’ classification, heat treatment, applications.
12. **Light metal alloys:** main categories (Al,Ti), properties, heat treatment and applications.
13. **Copper alloys:** Classification, main properties, heat treatment and applications.

### Laboratory
The workshop includes three modules and the following laboratory exercises:

1. **Introduction:** Standards, Directives and standardization of laboratory testing, structure of technical reports, verification and calibration of measuring devices, Conformity verification of metallic products, safety rules in testing laboratories.
2. **Module A** (five distinct laboratory exercises): Quality control measurements (hardness testing, microscopic examination of metals, reinforcing concrete steels’ conformity verification according to the latest Greek regulation, temperature measurements with thermocouples, heat treatment furnaces, thermal analysis of alloys).
3. **Module B** (four distinct laboratory exercises): Design and implementation of heat treatment on plain carbon steels (1045 or 1060 AISI), Design and implementation of heat treatment of O1 AISI tool steel.
4. **Module C**: Practical training in groups. Design of one of the implemented heat treatments of module B. Heat treatment sequence control by hardness testing and metallographic analysis of the steel structure. Evaluation of the heat treatment and proposal of possible corrections in order to comply with the design requirements.
### DELIVERY

- Face-to-face, Distance learning, etc.

Lectures and exercises, face-to-face.

### USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

- Use of ICT in teaching, laboratory education, communication with students

Using ICT in teaching (projectors, e-notes, digital technical brochures), in Laboratory exercises (software for thermocouple measurements, optical microscopy, chemical analysis of materials, optical stereoscopy), in communication and course electronic submission.

### TEACHING METHODS

- The manner and methods of teaching are described in detail.
- Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
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<tbody>
<tr>
<td>Lectures</td>
<td>39</td>
</tr>
<tr>
<td>Laboratory Exercises</td>
<td>26</td>
</tr>
<tr>
<td>Preparation for Writing Laboratory reports</td>
<td>10</td>
</tr>
<tr>
<td>Preparing on for Writing Laboratory reports-homework</td>
<td>10</td>
</tr>
<tr>
<td>Preparation on case studies (individual or group work)</td>
<td>10</td>
</tr>
<tr>
<td>Personal study</td>
<td>40</td>
</tr>
<tr>
<td>Total Course</td>
<td>125</td>
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</table>

### STUDENT PERFORMANCE EVALUATION

- Description of the evaluation procedure
- Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, etc.

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

Language of evaluation: Greek and English for ERASMUS students.

**Theory:** 60%

Final Written examination. Open references.

**Laboratory exercise:** 40%

Three modules consisting of three to five exercises with two written examinations with open references and a group project. The evaluation of laboratory part consist of:

- First module (five laboratory exercises), 40%:
  - Each laboratory exercise the first section requires individual technical report
  - Written examination consisting of problem solving. Open references.

- Second module (four laboratory exercises), 40%:
  - Written examination consisting of multiple choice questionnaires. Open references.

- Third module, 20%:
  - Technical report based on the group project.

At the beginning of each semester students take the exam questionnaires from the previous semester and the evaluation procedure.
## ATTACHED BIBLIOGRAPHY

### Textbooks (in Greek)


### Relevant Scientific Journals

- Materials Science and Engineering A, B, C
- Metallurgical Transactions
- Acta Materialia
- Journal of Alloys and Compounds
- Materials and Design