ETE 903. Engineering Alloys

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETE 903	**SEMESTER**	**9th**
COURSE TITLE	ENGINEERING ALLOYS		

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures and exercises	3	3
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialized general knowledge, skills development*	specialized general knowledge
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://ecourse.uoi.gr/course/view.php

(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 for 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*

Learning objectives: This course intends to give a rounded and detailed coverage in several of the most important engineering alloys of modern technology. It also aims at demonstrating the practical application of the metallurgical science principles taught in the fundamental courses of "Physical Metallurgy I" and "Physical Metallurgy II". For these reasons, the course is not just a net listing of the alloys and their applications but emphasis is given on the analysis of the processes and treatments, properties and applications of the alloys. The course has the following specific learning objectives:

- Acquirement of knowledge on metallic alloys and high added value materials, which cover a wide range of industrial applications from conventional to advanced ones. More specifically, the course covers the families of stainless steels, tool steels, nickel alloys,

superalloys and titanium alloys.

- Understanding the connection of the constituents and microstructural features with their properties and applications.
- Analysis of the theoretical background of the microstructure-property interrelation as well as the theoretical background of the treatments for the control and improvement of the alloy properties.

The main learning outcomes of the course:

- Specialized theoretical knowledge in subjects concerning: a) the creation and characterization of microstructure in complex metallic systems, b) the factors affecting and controlling the relationship between the microstructure and properties, and c) the processes associated with various microstructural transformations, always taking into consideration the attainment of optimum properties.
- Knowledge on the morphological features and characteristic properties of large categories of metallic alloys and high added value materials with improved properties, which cover a large part of engineering applications, from classical to advanced ones.
- Knowledge on new and/or advanced families of alloys in the forefront of technology.
- Knowledge on new applications of high industrial significance and the respective requirements for optimized properties.

Skills and competences of the students upon successful completion of the course: Upon the successful completion of the course, the student:

- Has become familiarized with new and/or advanced categories of metals and alloys in the technology forefront, which present improved properties and flexibility-wide range in their applications.
- Has acquired the ability to understand and foresee the behavior of a material and select the suitable material and treatment for a specific application.
- Has acquired specialized theoretical skills in matters concerning: a) the formation and characterization of a microstructure in complex metallic systems, b) the factors affecting and controlling the microstructure-properties relationship, and c) the processes associated with various microstructure transformations, always taking into account the attainment of optimum properties.
- Has become familiarized with new applications of high engineering value and the respective requirements for optimum properties.
- Is in a position to propose the appropriate group and type of alloy for an application and its respective requirements.
- Has acquired the skills to design an alloy with respect to the properties and the corresponding application.

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*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
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…*
	…….

- Decision-making
- Working independently
- Team work
- Production of new research ideas
- Production of free, creative and inductive thinking

- Respect of and attention to the human safety
- Apprehension of the value of prevention

(3) SYLLABUS

- Classification of metallic materials. The role of alloying elements in steels.
- Designation of steels and non-ferrous alloys.
- Stainless steels: Classification. Heat treatments. Microstructures, Properties, Applications. Wrought products. Cast products.
- Tool steels: Heat treatments, Microstructures, Properties, Applications. Wrought products. Powder metallurgy products.
- Nickel and its alloys: Hardening mechanisms. Hardening by cohesive precipitates. Solid solution strengthened alloys. Alloys of controlled thermal expansion. Alloys of electrical applications. Shape memory alloys. Soft magnetic alloys. Wrought nickel alloys.
- Superalloys: Heat treatments, Microstructures, Properties, Applications. Cast alloys. Directional solidification. Introduction into gas turbines. New materials for gas turbine blades. Powder metallurgy products.
- Titanium and its alloys: Classification. Heat treatments. Microstructures, Properties, Applications. Weldings. Product forms. Selection criteria.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Power point, MS Teams, e-course, e-mails
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*	

Activity	***Semester workload***
Lectures	39 h
Student's study hours	36 h
Course total	***75 h***

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, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	LANGUAGE OF EVALUATION: Greek METHOD OF EVALUATION: Written examination at the end of the semester consisting of exercises, problems and judgement questions For the Erasmus students: Solution of exercises + written essay (60% of the total score)

(5) SUGGESTED BIBLIOGRAPHY

-Suggested books:

1. A. Lekatou, Engineering Alloys, Papasoteriou Pub., ISBN 960-7530-62-4
2. A. Lekatou, Corrosion and protection of metals in simple words, Nemertes Pub., 2014, ISBN 978-960-9951-2-4
3. A. Lekatou, Introduction into the corrosion and protection of metals, Theodorides Pub., 2010, ISBN: 978-960-86109-9-6
4. A. Lekatou, Phase Transformations in Metals, Theodorides Publications, Ioannina 2009, ISBN-978-960-86109-8-9.
5. A. Lekatou & S. Lekatos, Introduction into Physical Metallurgy, Theodorides Publications, Ioannina, 2009, ISBN-978-960-86109-8-9
6. HKDH Bhadeshia & RWK Honeycombe, Steels: Microstructure and Properties, Butterworth-Heinemann, 2006, ISBN 9780750680844
7. I. Polmear, Light Alloys, 4th Edition - From Traditional Alloys to Nanocrystals, Butterworth-Heinemann, 2005, ISBN 9780750663717
8. R. C. Reed, The Superalloys: Fundamentals and Applications, Cabdridge University Press, 2006, ISBN: 978-0521070119
9. B. Geddes, H. Leon, X. Huang, Superalloys: Alloying & Performance, ASM, ISBN: 978-1615030408
10. J.R. Davies, Alloying: Understanding the Basics, ASM Int. 2001, DOI:10.1361/autb2001
11. J.R. Davis, Copper and Copper Alloys, ASM, 2001, ISBN:0-87170-726-8
12. D. G. Altenpohl, Aluminum: Technology, Applications and Environment: A Profile of a Modern Metal Aluminum from Within, 6th Edition, Wiley, 2010, ISBN: 978-0-87339-406-2
13. M. J. Donachie, Titanium: A Technical Guide, 2nd Edition, ASM, 2001, ISBN:0-87170-686-5
14. Z. Li, W. Gao, High temperature corrosion of intermetallics, Nova Science Pub, 2009, ISBN 978-1-60692-082-4
15. M.Schutze, Corrosion and environmental degradation, Wiley, 2000, ISBN 3-527-29505-4

et al.

-Relevant scientific journals:

16. Materials Science & Engineering
17. Materials & Metallurgical Transactions
18. Journal of Materials Engineering & Performance
19. Ironmaking & Steelmaking
20. Steel research
21. Advanced Engineering Materials
22. Metals-MDPI
23. Int. J. of Refractory Metals and Hard Materials
24. Canadian Metallurgical Quarterly
25. The Journal of The Minerals, Metals & Materials Society (TMS)
26. Journal of Alloys and Compounds
27. Materials & Design
28. Corrosion Science
29. Corrosion and Materials Degradation
30. Surface & Coatings Technology
31. Construction and Building Materials

et al.

-Websites

http://www.materialstoday.com/
http://www.bssa.org.uk/
http://www.nickelinstitute.org/
http://www.aluminum.org/
www.iom3.org/
www.metalinfo.com/
www.matweb.com/
http://www.recyclemetals.org/about_metal_recycling
et al.