COURSE DESCRIPTION CARD - SYLLABUS

Course name
Basics of heat treatment [S1IBio1E>POC]

Course

Field of study
Biomedical Engineering

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Knowledge: basics of chemistry, physics and science of materials; Skills: the ability to think logically, use of information obtained from libraries and the Internet; Social competencies: understanding the need to learn and acquire new knowledge.

Course objective

Getting to know the principles and types of heat treatment, understanding changes taking place during heat treatment and their effects on the structure and properties of metals and their alloys.

Course-related learning outcomes

Knowledge:
1. Student should know how to name and describe basic methods of heat treatment and mechanisms of transformations which occur during heat treatment.
2. Student should characterize properties of materials related to heat treatment method applied.

Skills:
1. Student know how to select appropriate heat treatment technology to material properties required.

2. Student know how to interpret the structure and properties of metal alloys after heat treatment, based on their knowledge of phase and structure transformations.

Social competences:
1. Student are willing to work in teams in order to solve problems.
2. Student are well aware of the significance of different types of heat treatment methods that determine properties of materials and products.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Assessment at the end of the semester: <90–100> 5.0 (A); <80–90) 4.5 (B); <70–80) 4.0 (C); <60–70) 3.5 (D); <50–60) 3.0 (E); <0–50) 2.0 (F)

Forming rating:
a) in the field of laboratory classes based on oral or writing responses from each exercise,
b) in the field of lectures based on pass conducted during the last lecture classes.
Summary rating:
a) in the laboratory classes, the average of grades obtained from the exercises,
b) in the field of lectures - pass in a written form.

Programme content

- Devices used in heat treatment.
- Definition and classification of heat treatment.
- Characterization and analysis of changes in iron alloys during heating and cooling.
- Hardenability and hardenability test methods.
- Heat treatment of ferrous alloys and selected non-ferrous alloys.
- The influence of heat treatment processes on the structure and properties of metal alloys.

Course topics

Lectures:
1. Classification and characterizations of heat treatment furnaces.
2. Principles and classification of basic types of metal and alloys heat treatment: annealing, hardening, tempering, supersaturating and ageing.
3. Transformation analysis in iron alloys during heating and cooling.
4. Transformation characteristics for phenomena interpretation during heat treatment i.e. pearlite, martensite and bainite heat treatment and transformations during tempering.
5. Hardenability and its significance for selection of construction materials. Methods of studying hardening.
6. Heat treatment of selected metals and their alloys: iron, aluminium, titanium and copper.
7. Influence of heat treatment processes on properties of materials.
8. Introduction to heat exchange in heat treatment furnaces.

Laboratory classes:
1. Introduction to basic issues in heat treatment.
2. Heat treatment of iron alloys - theory and practice.
3. Hardenability as a criterion for steel selection.
4. Supersaturating and ageing of non-ferrous alloys.
5. Thermochemical treatment: nitriding, carburizing and boriding.

Teaching methods

Lecture: multimedia presentation, examples of samples after various processes, discussion
Laboratory: practical exercises, solving tasks, discussion

Bibliography

Basic:
1. Banerjee M.K.: Fundamentals of Heat Treating Metals and Alloys. Malaviya National Institute of Technology, Jaipur, India, Elsevier, 2017

2. Callister W.D., Rethwisch D.G.: Materials Science and Engineering an Introduction. Wiley, 2018
3. Ashby M.F. Jones D.R.H.: Engineering Materials 2. An Introduction to Microstructures, Processing and Design. Elsevier, 2006
4. Ashby M.F.: Materials Selection in Mechanical Design. Elsevier, 2005

Additional:
1. Bryson W.E.: Heat Treatment Master Control Manual. Hanser Publishers, 2015
2. Cain T.: Hardening, Tempering and Heat Treatment. Workshop practice series no.1. Argus Books Ltd, 1990
3. Prabhudev K.H.: Handbook of Heat Treatment of steels. Tata McGraw-Hill Publishing Company Limited, 1988
4. Thelning K.E.: Steel and its Heat Treatnment. Bofors Handbook, 1981
5. Diggs T.G., Rosenberg S.J., Geil G.W.: Heat Treatment and Properties of Iron and Steel. National Bureau of Standards Monograph 88, 1966
6. Ashby M.F. Jones D.R.H.: Engineering Materials 1. An Introduction to Properties, Applications, and Design. Elsevier, 2012
7. Ashby M., Shercliff H., Cebon D.: Materials. Engineering, Science, Processing and Design. Elsevier, 2014
8. Davis J.R.: Aluminum and Aluminum Alloys. ASM International. DOI:10.1361/autb2001p351
9. Czerwinski F.: Thermochemical Treatment of Metals. http://dx.doi.org/10.5772/51566
10. Jacquot P.: Nitriding, Boriding and Carburizing of Steels. Chapter, 1992, DOI: 10.1007/978-94-017-0631-5_4

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00