COURSE DESCRIPTION CARD - SYLLABUS

Course name
Metal science with heat treatment [N1MiBP1>MzOC]

Course

Field of study
Mechanical and Automotive Engineering

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
18

Laboratory classes
9

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Knowledge: Basic knowledge of metallurgy and heat treatment of metals: construction of metals and alloys, carbon and alloy steels, non-ferrous metal alloys, steel corrosion, properties and practical application. Skills: Conducting some research in the field of metallurgy and heat treatment and testing the properties of alloys and steels: annealing, hardening and tempering, nitriding and carburizing, metallographic tests (determination of hardness, thickness of diffusion layers, etc.) Social competences: The student is aware of the importance of technical activity, understands the need for development and education

Course objective

Getting to know the theoretical basis of the construction of metals and their alloys. Getting to know the basics of heat and thermo-chemical treatment of steels and metals and their alloys. Understanding the grades of non-alloy and alloy steels, cast steels, cast irons and selected non-ferrous metal alloys: their physical and functional properties and their practical application.

Course-related learning outcomes

Knowledge:
Has basic, ordered knowledge of metal materials used in mechanical engineering, such as iron,

aluminum, copper, etc. alloys used in machine building, and in particular about their structure, properties, methods of production, heat and thermo-chemical treatment, and the influence of plastic working on their endurance.
Has a basic, structured knowledge of non-metallic and composite materials used in the construction and operation of machines, mainly ceramic materials, synthetic materials, non-metallic natural materials (wood, glass, stone) and fuels, lubricants, technical gases, refrigerants, etc.
Has basic knowledge of the strength of materials, including the basics of the theory of elasticity and plasticity, stress hypotheses, calculation methods for beams, membranes, shafts, joints and other simple structural elements, as well as methods of testing the strength of materials and the state of deformation and stress in mechanical structures.

Skills:
Can obtain information from literature, the Internet, databases and other sources. Can integrate the obtained information, interpret and draw conclusions from it, and create and justify opinions.
Can search in catalogs and on manufacturers" websites ready-made machine components to be used in his own projects.
Can design a technology of making a simple machine element as well as a technology for assembling and disassembling a machine.

Social competences:
Is ready to critically assess his knowledge and received content.
Is ready to initiate actions for the public interest.
Is ready to fulfill professional roles responsibly, including:
- observing the rules of professional ethics and requiring this from others, - caring for the achievements and traditions of the profession.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Written and oral exam; written and oral exam

Programme content

General characteristics of materials
Importance of materials in product manufacturing processes; manufacturing processes, materials used in manufacturing processes.
Basic groups of engineering materials; metals and their alloys, polymers, ceramics, composites.
The structure of metals
Structure of matter; matter and its components, structure of the atom, classification of chemical elements, bonds between atoms.
The actual structure of metals; classification of crystalline structure defects, point defects, dislocations, interaction between dislocations, polycrystalline structure of metals, grain boundaries and interfacial boundaries, the influence of defects in the crystal structure on the properties of metals.
Metal alloys and their structure
Metal alloys and alloy phases, general information on metal alloys, solid solutions, intermetallic phases, interstitial phases, phase mixtures.
Iron alloys with carbon
Iron-carbon system; iron and its properties, iron-carbon equilibrium diagram, phase transitions during cooling of iron-carbon alloys, general classification of iron-carbon alloys.
Carbon cast iron; general classification of carbon cast irons, graphite as a structural component of cast iron, influence of the cooling rate on the structure and properties of cast irons, gray cast iron, white and half cast iron, malleable cast iron, comparison of the properties of carbon cast iron.
Heat treatment of steel
General description of heat treatment,
Phase transitions during heat treatment of steel; transformations in steel during: heating, cooling, hardening, tempering, dispersion hardening,
Thermo-chemical treatment of steel
Theoretical foundations of thermo-chemical treatment; thermo-chemical treatment and its classification, chemical phenomena occurring during thermo-chemical treatment

Diffusion impregnation of steel with non-metals and metals; carburizing, nitriding, boriding, diffusion saturation of steel with metallic elements, comprehensive thermo-chemical treatment
The role of alloying elements in steels
The importance of alloying elements: dissolved in solid solutions, in carbides and nitrides, in intermetallic phases,
The influence of alloying elements on the basic properties of steel and other iron alloys
Alloy steels and their importance
Classification of alloy steels
Structural alloy steels and their heat treatment; general characteristics, low-alloy weldable structural steels, structural alloy steels for thermal improvement, structural alloy steels for nitriding and carburizing, spring steels, alloy steels for rolling bearings.
Alloy tool steels and their heat treatment; general characteristics, alloyed tool steels for cold work, alloyed tool steels for hot work, high-speed steels.
Steels and iron alloys with special properties; general characteristics, corrosion-resistant steels, alloyed steels for operation at elevated temperature, heat-resistant and creep-resistant steels, steels for operation at low temperatures, martensitic dispersion-hardened maraging steels, abrasion resistant steels, steels and alloys with special magnetic properties
Cast iron and alloy steel
Alloy cast iron; general characteristics of alloy cast irons, cast iron with increased abrasion resistance, corrosion-resistant alloy cast iron, heat-resistant and heat-resistant alloy cast iron, alloy cast iron for low temperature operation, alloy cast iron with special physical properties.
Alloy cast steels: general characteristics of alloy cast steels, structural alloy cast steels, corrosion-resistant alloy cast steels, heat-resistant and heat-resistant alloy cast steels, tool alloy cast steels.
Non-ferrous metals and their alloys:
Aluminum and its alloys; general classification of aluminum alloys, aluminum-silicon alloys, aluminum-magnesium alloys, aluminum-copper alloys, multi-component aluminum-zinc alloys, aluminum-manganese alloys
Corrosion of metals and alloys
Corrosion, its varieties and mechanisms; corrosion and its effects, types of corrosion damage, electrochemical corrosion, gas corrosion, mechanisms of gangrene formation, factors influencing gas corrosion.
Corrosion protection; selection of the chemical composition of alloys to increase corrosion resistance, cathodic, sacrificial and anodic protection, inhibitors, coatings and protective layers, other methods of corrosion prevention.

Course topics

none

Teaching methods

Lecture with multimedia presentation. Laboratory classes.

Bibliography

Basic
1. S. Rudnik: Metaloznawstwo. PWN, Warszawa, 1996
2. F. Staub; Metaloznawstwo, 1979
3. W. Luty [i in.]: Poradnik inżyniera. Obróbka cieplna stopów żelaza, 1977
4. L. Dobrzański: Metaloznawstwo z podstawami nauki o materiałach. WNT, Warszawa, 1996
5. S. Prowans: Metaloznawstwo. PWN, Warszawa, 1988
6. K. Przybyłowicz: Metaloznawstwo. WNT, Warszawa, 1996
7. L. A. Dobrzański: Metaloznawstwo i obróbka cieplna
8. L. A. Dobrzański: Podstawy nauki o materiałach i metaloznawstwo, WNT, Gliwice 2002
Additional
1. Michael Ashby i in.: Inżynieria materiałowa tom I i II, Wydawnictwo Galaktyka, 2006
2. Michael Ashby i in.: Materiały inżynierskie tom I i II, WNT, 1996
3. Poradnik Inżyniera: Obróbka cieplna metali, WNT, 1979
4. Mały poradnik mechanika, tom I i II, WNT1999
5. Wilhem Domke: Vademecum materiałoznawstwa, NT, 1997
6. Feliks Wojtking, Jurij Soncew: Materiały specjalnego przeznaczenia, Wydawnictwo Politechniki

Radomskiej, 2001

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	32	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	68	2,00