AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Mechanical Response of Engineering Materials

Academic year: 2019/2020 Code: ZSDA-3-0122-s ECTS credits: 3

Faculty of: Szkoła Doktorska AGH

Field of study: Szkoła Doktorska AGH Specialty: —

Study level: Third-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 0

Course homepage: —

Responsible teacher: dr hab. inż. Muszka Krzysztof (muszka@agh.edu.pl)

Module summary

The student acquires knowledge about prediction, control and use of the basic properties of engineering materials.

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Skills: he can			
M_U001	- an ability to use the techniques, skills, and experimental, computational and data analysis tools necessary for materials engineering practice. Effective communication skills regarding the mechanical response of materials.	SDA3A_U04, SDA3A_U03	Examination, Activity during classes
Knowledge: he knows and understands			
M_W001	student gains an ability to understand the drivers and solutions for building lighter, safer, efficient and affordable constructions	SDA3A_W02, SDA3A_W07, SDA3A_W01	Examination, Activity during classes
M_W002	- an ability to apply knowledge of mathematics, science, and engineering to problems in materials engineering. Conversant with conventional nomenclature, units and notation of mechanical behavior. - an ability to estimate relative ranges and values for important properties of common engineering materials.	SDA3A_W02, SDA3A_U01	Examination, Scientific paper, Activity during classes

M_W003	- Optimize the alloy design, thermomechanical processing and heat treatment for the applicable mechanical application of the alloy and metal.	SDA3A_W02	Examination, Presentation, Activity during classes

Number of hours for each form of classes

	Form of classes										
Suma	Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
30	15	0	0	0	0	15	0	0	0	0	0

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
Skills: he can												
M_U001	- an ability to use the techniques, skills, and experimental, computational and data analysis tools necessary for materials engineering practice. Effective communication skills regarding the mechanical response of materials.	+	-	-	-	-	+	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	student gains an ability to understand the drivers and solutions for building lighter, safer, efficient and affordable constructions	+	-	-	-	-	+	-	-	-	-	-
M_W002	- an ability to apply knowledge of mathematics, science, and engineering to problems in materials engineering. Conversant with conventional nomenclature, units and notation of mechanical behavior. - an ability to estimate relative ranges and values for important properties of common engineering materials.	+	-	-	-	-	-	-	-	-	-	-

M_W003	- Optimize the alloy design, thermomechanical processing and heat treatment for the applicable mechanical application of the alloy and metal.	+	-	-	-	-	+	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	30 h
Preparation for classes	15 h
przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania	15 h
Realization of independently performed tasks	15 h
Examination or Final test	2 h
Summary student workload	77 h
Module ECTS credits	3 ECTS

Additional information

Module content

Lectures

The course will be focused on the fundamental mechanisms that operate at meso-, micro- and nano-meter scale across a wide-range of engineering materials, in a way that is mathematically simple and requires no extensive knowledge of materials. This integrated approach provides a conceptual presentation that shows how the microstructure of a material controls its mechanical behavior. The first objective of the course is to understand the drivers and solutions for building lighter, safer, efficient and affordable constructions. The second objective is to examine the complex interrelationship between composition, processing, microstructure and mechanical properties. The third objective is to review the design, guidelines, manufacturing hurdles, advanced forming, sustainability, and evolving grades of advanced structural materials. Macroscopic mechanical response of engineering materials, first of all metals and alloys will be related to elasticity and plasticity concepts for single crystal and polycrystalline materials. Practical design considerations for deformation will be included as well as an introduction to fracture mechanisms.

Seminar classes

During the seminar classes students prepare presentations aimed at gaining practical knowledge on the following subjects:
•How to use applied mathematics and continuum mechanics in the mechanical assessment of materials. Stress, strain, yield strength, fracture strength. Yield criteria, flow rules, creep, fracture
•Yield strength ranges for ductile metals. Plastic deformation mechanisms.
•Relate microstructure to properties of crystalline solids. Strengthening mechanisms in crystalline solids.

•Effective presentation of data in figures and tables. Describe data regarding deformation and failure of materials and relate it to the expected behavior based on well established models or theories.
•Understand metallurgical and mechanical aspects of forming of metals into useful shapes and properties. How will the material change shape for the applied deformation? What kind of deformation mechanism will operate? Which slip system(s) will be operative?
•Dislocation glide, cross-slip, dislocation climb, precipitation strengthening. Nabarro-Herring creep. Plane strain fracture.

Teaching methods and techniques:

Lectures:
Learn to pronounce
The content of the lecture is transmitted in the form of a multimedia presentation in
in combination with a classic blackboard lecture enriched with shows relating to
issues presented.
Seminar classes: The basis for seminar classes is the multimedia and oral presentation led by students. Another important element of education are the answers to the questions raised, as well as the students' discussion of the presented content.

Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, a także warunki dopuszczenia do egzaminu:

The condition for obtaining credit for the seminar is the preparation and presentation of the presentation during the seminar on a selected topic – topics will be given by the lecturers at the beginning of the semester.

Zasady udziału w poszczególnych zajęciach, ze wskazaniem, czy obecność studenta na zajęciach jest obowiązkowa:

Lectures:
– Attendance is mandatory: No
– Participation rules in classes:
Students participate in classes learning the next content of teaching
according to the item syllabus. Students should keep asking questions and clarifying doubts.
Audiovisual registration of the lecture requires the teacher's consent.
Seminar classes:
– Attendance is mandatory: Yes
– Participation rules in classes: Students prepare presentation on the topic indicated by the lecturer, present on the student group forum and participate in the discussion on this topic. Both the substantive value of the presentation and the so-called soft skills are evaluated.

Method of calculating the final grade

Average: (Exam• 0.6 + Seminar • 0.4)

Sposób i tryb wyrównywania zaległości powstałych wskutek nieobecności studenta na zajęciach:

Student who misses a seminar class should prepare and present his work during the next class.

Prerequisites and additional requirements

Basic knowledge of English is obligatory

Recommended literature and teaching resources

G.E. Dieter, Mechanical Metallurgy, McGraw Hill Publishing Co., New York.
M.A. Meyers and K. Chawla, Mechanical Behavior of Materials, Prentice Hall

T. H. Courtney. Mechanical Behavior of Materials, Second Edition.
(Waveland Press, Inc.: Long Grove, IL) 2000, 2005
M.F. Ashby and D.R.H. Jones, Engineering Materials 1, Butterworth-Heinemann
M.A. Mayers, Dynamic Behavior of Materials, John Wiley & Sons, New York, 1994

Scientific publications of module course instructors related to the topic of the module

https://bpp.agh.edu.pl/

Additional information

None