AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

| | | | | | |
|---|---|---|---|---|---|
| Module name: | Dobór technik wytwarzania i kształtowania materiałów dla podstawowych grup materiałowych | | | | |
| Academic year: | 2019/2020 | Code: | ZSDA-3-0176-s | ECTS credits: | 2 |
| 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: | Polski i Angielski | Profile of education: | Academic (A) | Semester: | 0 |
| Course homepage: | — | | | | |
| Responsible teacher: | prof. dr hab. inż. Jaworska Lucyna (ljaw@agh.edu.pl) | | | | |

### Module summary

Students will learn about the principles of selection of manufacturing techniques for the shaping of products for four basic groups of materials, depending on their properties. The basic features of the microstructure of materials obtained by such techniques as: metal forming, casting, sintering, machining and additive methods will be discussed. PhD students will become familiar with material shortcomings resulting from the use these techniques as well as with methods that limit these drawbacks

## 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) |
|---|---|---|---|
| Social competence: is able to | | | |
| M_K001 | Critical assessment of the achievements in the field of manufacturing techniques and their impact on the properties of shaped materials, critical assessment of their own contribution to the development of material engineering, recognition of the importance of knowledge in solving cognitive problems in the field of product and practical process development; | SDA3A_K01 | |
| Skills: he can | | | |

| | | | |
|---|---|---|---|
| M_U001 | To use knowledge in the field of materials engineering and mechanical engineering to creatively identify, formulate and innovative solving of complex problems in the selection of techniques for shaping different materials, in particular: define the goal and subject of scientific research, formulate a research hypothesis; develop methods, techniques and research tools and apply them creatively; conclude on the basis of the results of scientific research; perform critical analysis and evaluation of the results of scientific research, expert activities and other creative work as well as their contribution to the development of knowledge; transfer the results of scientific activity to the economic and social sphere; | SDA3A_U01 | Test |
| Knowledge: he knows and understands | | | |
| M_W001 | To the extent enabling revision of existing paradigms, global achievements in the field of production techniques and materials science, covering theoretical foundations and general issues and selected specific issues relevant to material engineering or scientific disciplines within which they are preparing a doctoral dissertation in the appropriate selection of material shaping techniques | SDA3A_W01 | Test |
| M_W002 | Fundamental dilemmas of modern civilization in the field of producing new "non-technological" materials; | SDA3A_W05 | Test |
| M_W003 | Economic, legal, ethical and other important conditions for scientific activity in the field of shaping new material groups | SDA3A_W06 | Test |

## 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 |
| 15 | 15 | 0 | 0 | 0 | 0 | 0 | 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 |
| Social competence: is able to | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M_K001 | Critical assessment of the achievements in the field of manufacturing techniques and their impact on the properties of shaped materials, critical assessment of their own contribution to the development of material engineering, recognition of the importance of knowledge in solving cognitive problems in the field of product and practical process development; | + | - | - | - | - | - | - | - | - | - | - |
| Skills: he can | | | | | | | | | | | | |
| M_U001 | To use knowledge in the field of materials engineering and mechanical engineering to creatively identify, formulate and innovative solving of complex problems in the selection of techniques for shaping different materials, in particular: define the goal and subject of scientific research, formulate a research hypothesis; develop methods, techniques and research tools and apply them creatively; conclude on the basis of the results of scientific research; perform critical analysis and evaluation of the results of scientific research, expert activities and other creative work as well as their contribution to the development of knowledge; transfer the results of scientific activity to the economic and social sphere; | + | - | - | - | - | - | - | - | - | - | - |
| Knowledge: he knows and understands | | | | | | | | | | | | |
| M_W001 | To the extent enabling revision of existing paradigms, global achievements in the field of production techniques and materials science, covering theoretical foundations and general issues and selected specific issues relevant to material engineering or scientific disciplines within which they are preparing a doctoral dissertation in the appropriate selection of material shaping techniques | + | - | - | - | - | - | - | - | - | - | - |
| M_W002 | Fundamental dilemmas of modern civilization in the field of producing new "non-technological" materials; | + | - | - | - | - | - | - | - | - | - | - |
| M_W003 | Economic, legal, ethical and other important conditions for scientific activity in the field of shaping new material groups | + | - | - | - | - | - | - | - | - | - | - |

## Student workload (ECTS credits balance)

| Student activity form | Student workload |
|---|---|
| Udział w zajęciach dydaktycznych/praktyka | 15 h |
| Preparation for classes | 10 h |
| Realization of independently performed tasks | 5 h |
| Examination or Final test | 1 h |
| Contact hours | 2 h |
| Summary student workload | 33 h |
| Module ECTS credits | 2 ECTS |

## Additional information

## Module content

**Lectures**

The student will learn about the principles of selection of manufacturing techniques for the production and shaping of products for four basic groups of materials: metals, polymers, ceramics and composites, depending on their properties. The basic features of the microstructure of materials obtained by such techniques as: metals forming, casting, sintering, machining and 3D additive methods will be discussed. Doctoral students learn about the phenomena and material defects resulting from the use of the above-mentioned techniques such as: strengthening, grain growth for various techniques, porosity, thermal stresses, casting defects, microstructure discontinuities, dendrites, macrosegregation, lack of adhesion and wettability. They learn destructive and non-destructive methods to assess the basic physical and mechanical properties of materials. They become acquainted with methods improving the state of microstructure and properties for individual production techniques, learn about technological treatments and new devices that eliminate material defects generated in individual production techniques. They learn about thermal treatments and methods of surface layer modification.Lecture content:
1. Evaluation of the possibility of shaping products from the point of views  the material properties: chemical bonds, crystal structure, defects, thermal and mechanical properties. The basic characteristics of the manufacturing techniques – 3 hours.
2. Foundry, casting defects, their detection, methods of repairing castings and prevention of foundry defects – 2 hours.
3. Sintering, modern sintering methods, selection of sintering methods for selected material groups. Porosity, shrinkage, grain growth, methods of limiting their influence on compacts properties – 2 hours.
4. Metals forming, type of metods. Strengthening the material due to deformation, recovery and recrystallization, recrystallizing annealing – 2 hours.
5. Machining, conventional and non-conventional. Thermal stresses, surface quality, changes in the chemical composition of the surface layer. Selection of the method for processing for selected groups of materials-  2 hours.
6. 3D additive methods. Porosity and surface roughness, methods of improving the condition of the surface layer. Properties of products manufactured by 3 D methods –

2 hours.

## Teaching methods and techniques:

Lectures: The content presented at the lecture is provided in the form of a multimedia presentation in combination with a classical lecture panel enriched with demonstrations relating to the issues presented.

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

Passing the lectures based on the finale test. Preferred presence at lectures.

## 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 the classes learning the next teaching content according to the syllabus of the subject. Students should constantly ask questions and explain doubts. Audiovisual recording of the lecture requires the teacher’s consent.

## Method of calculating the final grade

The final grade is the test grade.

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

In the case of failure to write a test on the lecture content, for a justified reason, pass the colloquium at a different date agreed with the lecturer.

## Prerequisites and additional requirements

Prerequisites and additional requirements not specified

## Recommended literature and teaching resources

1. D.R.Askeland, W.J.Wright, The Science and Engineering of Materials, Global Engineering Centrgage Learning, Boston 2015
2.P.A.Deartley, Introduction to surface Engineering, New York:Cambridge University Press, 2017.
3. P.T. Bolwijn et al. Flexible Manufacturing: Integrating Technological and Social Innoovation T.4. Amsterdam: Oxford; New York; Tokyo, Elsevier, 1989.Manufacturing Research and Technology

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

L. Jaworska, J. Cyboroń, S.Cygan, J.Laszkiewicz-Łukasik, M. Podsiadło, P.Novak, Y.Holovenko
New materials through a variety of sintering methods. [W:] IOP Conference Series: Materials Science and Engineering, E-MRS Fall Symposium I: Solutions for Critical Raw Materials Under Extreme Conditions 18–21 September 2017, Warsaw, Poland, 2018, Volume 329, nr 012004, s. 1-10.
I.Sulima, L.Jaworska, P.Figiel, Effect of boron sinter – aid on the microstructure and properties of austenitic stainless steel – TiB2 composites, Archive of Metallurgy and Materials , 2015, Vol. 60, nr 4, s. 2619-2624. [DOI: 10.1515/amm-2015-0423]. Institute of Metallurgy and Materials Science Polish Academy of Sciences. 2014 ISSN 1733-3490.
A.S.Osipov, P.Klimczyk, S.Cygan, I.A. Melniichuk, I.A. Petrusha, L. Jaworska: Composites of the cBN-Si3N4 system reinforced by SiCw for turning tools. Journal of Superhard Materials , 2016, Vol. 38, nr 1, s. 1-7. [DOI: 10.3103/S1063457616010019]. New York : Allerton Press Inc, 2016. ISSN 1063-4576, EISSN 1934-9408

L.Jaworska. Charakterystyka materiałów narzędziowych, [W] Spiekane materiały narzędziowe na ostrza narzędzi do obróbki z wysokimi prędkościami skrawania; pod redakcja L.Stobierskiego, Wydawnictwo Naukowe Akapit, Kraków, 2014

Jaworska L., Klimczyk P., Szutkowska M., Putyra P., Sitarz M. , Cygan S., Rutkowski P. Thermal resistance of PCD materials with borides bonding phase. Journal of Superhard Materials, Maj 2015, Vol. 37, Is. 3, s 155-165 IF: 0,5732015.6.4.

L. Jaworska, P. Putyra , P.Klimczyk, M.Zybura M. Nowe możliwości technologiczne i badawcze materiałów ceramicznych przeznaczonych na części maszyn i narzędzia. Mechanik , 2010, R. 83, nr 10, s. 710-713. (Seria Biuletyn). Agenda Wydawnicza SIMP. 2010 ISSN 0025-6552

L. Jaworska, Diament otrzymywanie i zastosowanie w obróbce skrawaniem. [W:] [Monografia], 128 s. Warszawa. Wydawnictwa Naukowo-Techniczne. 2007.

A.Twardowska, B.Rajchel, L.Jaworska: Ion beam assisted deposition of Ti-Si-C thin films, Journal of Achievements In Materiale and Manufacturing Engineering, Vol. 37, (2009), iss.1, s.87-90

## Additional information

None