



Module name: **Advanced metallic biomaterials**

Academic year: **2019/2020** Code: **ZSDA-3-0095-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, prof. AGH Moskalewicz Tomasz (tmoskale@agh.edu.pl)**

### Module summary

After completing the course the student will have a sound knowledge regarding the advanced metallic biomaterials including bioactive, biodegradable and antibacterial coatings and advanced coatings technologies as well as the fundamental aspects of additive manufacturing of metallic implants.

### 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                              | understands the social aspects of application of novel advanced materials and technologies in biomedical engineering                   | SDA3A_K01, SDA3A_K02            | Test results   |
| Skills: he can                      |  |                                 |  |
| M_U001                              | assess the problems in application of metallic materials in biomedical engineering.  | SDA3A_U03, SDA3A_U02            | Participation in a discussion, Presentation, Activity during classes |
| M_U002                              | select appropriate surface modification or coating for metallic biomaterial to enhance its properties for desired medical application. | SDA3A_U03, SDA3A_U02, SDA3A_U04 | Participation in a discussion, Presentation, Activity during classes |
| Knowledge: he knows and understands |  |                                 |  |
| M_W001                              | the advances in metallic biomaterials, limitations, current challenges and opportunities.  | SDA3A_W03, SDA3A_W02            | Test results   |

|        |  |                         |              |
|--------|--|-------------------------|--------------|
| M_W002 | the theoretical and practical aspects of types of advanced coating and coating technologies for metallic biomaterials. | SDA3A_W03,<br>SDA3A_W02 | Test results |
|--------|--|-------------------------|--------------|

## Number of hours for each form of classes

| Suma | Form of classes |                    |                    |                 |                      |                 |                   |                   |           |                               |          |
|------|-----------------|--------------------|--------------------|-----------------|----------------------|-----------------|-------------------|-------------------|-----------|-------------------------------|----------|
|      | Lectures        | Auditorium classes | Laboratory classes | Project classes | Conversation seminar | Seminar classes | Practical classes | Fieldwork classes | Workshops | Prace kontrolne i przejściowe | Lektorat |
| 20   | 10              | 0                  | 0                  | 0               | 0                    | 10              | 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                              | understands the social aspects of application of novel advanced materials and technologies in biomedical engineering                   | +               | -                  | -                  | -               | -                    | -               | -                 | -                 | -         | -                             | -        |
| Skills: he can                      |  |                 |                    |                    |                 |                      |                 |                   |                   |           |                               |          |
| M_U001                              | assess the problems in application of metallic materials in biomedical engineering.  | -               | -                  | -                  | -               | -                    | +               | -                 | -                 | -         | -                             | -        |
| M_U002                              | select appropriate surface modification or coating for metallic biomaterial to enhance its properties for desired medical application. | -               | -                  | -                  | -               | -                    | +               | -                 | -                 | -         | -                             | -        |
| Knowledge: he knows and understands |  |                 |                    |                    |                 |                      |                 |                   |                   |           |                               |          |
| M_W001                              | the advances in metallic biomaterials, limitations, current challenges and opportunities.  | +               | -                  | -                  | -               | -                    | -               | -                 | -                 | -         | -                             | -        |
| M_W002                              | the theoretical and practical aspects of types of advanced coating and coating technologies for metallic biomaterials.                 | +               | -                  | -                  | -               | -                    | -               | -                 | -                 | -         | -                             | -        |

## Student workload (ECTS credits balance)

| Student activity form   | Student workload |
|---|------------------|
| Udział w zajęciach dydaktycznych/praktyka                         | 20 h             |
| Preparation for classes   | 15 h             |
| przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania | 15 h             |
| Realization of independently performed tasks                      | 10 h             |
| Examination or Final test   | 2 h              |
| Summary student workload  | 62 h             |
| Module ECTS credits   | 3 ECTS           |

## Additional information

### Module content

#### Lectures

- 1.Traditional metallic biomaterials – limitations, current challenges and opportunities (2 h)
- 2.Development of alloys with low Young’s modulus. Development of shape memory and super elasticity alloys. Ni-free metallic biomaterials (2 h)
- 3.Surface modifications. Bioactive, biodegradable and antibacterial coatings for metals (2 h)
- 4.Advanced coating technologies for metallic biomaterials. Additive manufacturing of metallic implants (2 h)
- 5.Biodegradable metallic biomaterials (2 h)

#### Seminar classes

- 1.Shape memory alloys (2 h)
- 2.Bulk metallic glasses (2 h)
- 3.Progress in metallic implants for load bearing applications (2 h)
- 4.Additive manufacturing processes for metallic implants (2 h)
- 5.Electrophoretic deposition of coatings (2 h)

#### Teaching methods and techniques:

Lectures: The topics presented in the lecture are shown in the form of a multimedia presentation combined with the classic method of writing on a blackboard.

Seminar classes: The seminar classes are based on the multimedia and oral presentation of the students. Other important elements are the answers given by the students to received questions and the discussion between the students on the presented topic.

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

Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, zostaną podane na pierwszym wykładzie.

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

Lectures:

- Attendance is mandatory: No
- Participation rules in classes: Students that take part in the classes will learn subsequent topics according to the syllabus of the class. Students should systematically ask questions. Recording of the lecture can only be done with the approval of the lecturer.

Seminar classes:

- Attendance is mandatory: Yes
- Participation rules in classes: Students will present a topic provided by the lecturer in front of the group and take part in a discussion on the topic. Both the merit and the visual presentation will be graded.

## **Method of calculating the final grade**

Final grade = 0.5 • seminar grade + 0.5 • grade from the lecture test

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

Usprawiedliwiona nieobecność na zajęciach seminaryjnych może być odrobiona z inną grupą, ale tylko za zgodą prowadzących i pod warunkiem, że na zajęciach realizowany jest ten sam temat.

## **Prerequisites and additional requirements**

According to Regulamin Studiów AGH the basic term for obtaining credit is the last day of classes in a given semester. The terms of credit correction (method and conditions shall be determined by the leading teacher on the initial classes) can not be later than the last date of the exam session (for modules ending with an exam) or the last day of the semester (for modules ending without exam).

## **Recommended literature and teaching resources**

- 1.M. Niinomi, T. Narushima, M. Nakai (eds), Advances in Metallic Biomaterials: Tissues, Materials and Biological Reactions, Springer, 2015
- 2.M. Niinomi, T. Narushima, M. Nakai (eds), Advances in Metallic Biomaterials: Processing and Applications, Springer, 2015
- 3.Cuie Wen (ed), Surface Coating and Modification of Metallic Biomaterials, Woodhead Publishing, 2015
- 4.S. Nazarpour (ed), Thin Films and Coatings in Biology, Springer, 2013
- 5.John O. Milewski, Additive Manufacturing of Metals, Springer, 2017

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

<http://www.bpp.agh.edu.pl>

## **Additional information**

None