Module summary
Students become familiar with selected advanced structural and functional materials and relevant manufacturing routes which enable development of structures and properties required in specific applications. Case studies will be discussed on the basis of current scientific literature. Particular emphasis will be given to durability, reparability, upgradeability, design for disassembly, information, and ease of reuse and recycling in accordance with the European circular economy action plan.

Description of learning outcomes for module

<table>
<thead>
<tr>
<th>MLO code</th>
<th>Student after module completion has the knowledge/ knows how to/is able to</th>
<th>Connections with FLO</th>
<th>Method of learning outcomes verification (form of completion)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Social competence: is able to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M_K001</td>
<td>understands the necessity of continuous education and upgrading professional and personal competencies; knows the possibilities of continuous education and extending professional competencies;</td>
<td>SDA3A_K01, SDA3A_K03</td>
<td>Participation in a discussion</td>
</tr>
<tr>
<td>M_K002</td>
<td>understands the impact of chemistry on technological developments; is aware of possible side effects of technological advancement, including environmental issues, and necessity of taking responsible decisions</td>
<td>SDA3A_K01, SDA3A_K02, SDA3A_K02</td>
<td>Activity during classes</td>
</tr>
</tbody>
</table>

Skills: he can
M_U001 has sufficient skills to acquire new knowledge from textbooks, scientific journals, databases and internet sources, to critically evaluate the information and apply in the engineering practice; is able to use the information on the natural resources and industrially produced materials for the needs of technological developments.

SDA3A_U02, SDA3A_U05, SDA3A_U01, SDA3A_U04, SDA3A_U03

Presentation

Knowledge: he knows and understands

M_W001 has extended knowledge on the manufacturing, processing, properties and characterization methods of different groups of materials, including nanostructured materials; knows the principles of materials design; has basic knowledge on materials degradation.

SDA3A_W02, SDA3A_W05, SDA3A_W04, SDA3A_W01

Test results

<table>
<thead>
<tr>
<th>Form of classes</th>
<th>Lectures</th>
<th>Auditorium classes</th>
<th>Laboratory classes</th>
<th>Project classes</th>
<th>Conversation seminar</th>
<th>Seminar classes</th>
<th>Practical classes</th>
<th>Fieldwork classes</th>
<th>Workshops</th>
<th>Prace kontrolne i przejściowe</th>
<th>Lektorat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suma</td>
<td>30</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

FLO matrix in relation to forms of classes

<table>
<thead>
<tr>
<th>MLO code</th>
<th>Student after module completion has the knowledge/ knows how to/is able to</th>
<th>Form of classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lectures</td>
</tr>
<tr>
<td>M_K001</td>
<td>understands the necessity of continuous education and upgrading professional and personal competencies; knows the possibilities of continuous education and extending professional competencies;</td>
<td>-</td>
</tr>
</tbody>
</table>
M_K002 understands the impact of chemistry on technological developments; is aware of possible side effects of technological advancement, including environmental issues, and necessity of taking responsible decisions

Skills: he can

M_U001 has sufficient skills to acquire new knowledge from textbooks, scientific journals, databases and internet sources, to critically evaluate the information and apply in the engineering practice; is able to use the information on the natural resources and industrially produced materials for the needs of technological developments

Knowledge: he knows and understands

M_W001 has extended knowledge on the manufacturing, processing, properties and characterization methods of different groups of materials, including nanostructured materials; knows the principles of materials design; has basic knowledge on materials degradation;

Student workload (ECTS credits balance)

<table>
<thead>
<tr>
<th>Student activity form</th>
<th>Student workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Udział w zajęciach dydaktycznych/praktyka</td>
<td>30 h</td>
</tr>
<tr>
<td>Preparation for classes</td>
<td>30 h</td>
</tr>
<tr>
<td>przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania</td>
<td>10 h</td>
</tr>
<tr>
<td>Realization of independently performed tasks</td>
<td>5 h</td>
</tr>
<tr>
<td>Examination or Final test</td>
<td>2 h</td>
</tr>
<tr>
<td>Summary student workload</td>
<td>77 h</td>
</tr>
<tr>
<td>Module ECTS credits</td>
<td>3 ECTS</td>
</tr>
</tbody>
</table>

Additional information

Module content

Lectures

general scope:
- new paradigm in economy and European circular economy action plan
- current trends in materials science and engineering
- structural intermetallics,
- energy harvesting materials and systems
- nanostructures with predesigned properties
- materials in smart systems
- bioinspired functional materials and structures

**Seminar classes**

**general scope:**
- materials for batteries and solar cells
- graphene/silicene/maxene – type materials
- materials with controlled porosity
- materials for biomedical applications
- magnetorheological fluids
- biomimetic materials and structures
- sustainable/green manufacturing
- technologies used in additive manufacturing

**Teaching methods and techniques:**

Lectures: Formal lectures are supported by multimedia (presentations, illustrations, movies). Interaction with students is encouraged by asking questions and inviting to discussion.

Seminar classes: Seminar classes are based on the presentations prepared individually by students according to the schedule and recommended reading assignments. Each student is expected to lead discussion related to the topic of the seminar. Personal involvement of students in the discussion is marked and contributes to the final grade.

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

In accordance with general regulations at AGH UST.

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

Lectures:
- Attendance is mandatory: Yes
- Participation rules in classes: Participation is mandatory

Seminar classes:
- Attendance is mandatory: Yes
- Participation rules in classes: Participation is mandatory.

**Method of calculating the final grade**

final grade = 0.1 attendance + 0.2 discussion + 0.2 presentation + 0.5 final test

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

To be consulted with the instructor, individually.

**Prerequisites and additional requirements**

basic solid state chemistry/physics/materials technologies

**Recommended literature and teaching resources**
lecture notes + recommended scientific papers:

Scientific publications of module course instructors related to the topic of the module
Publications are available at: https://www.bpp.agh.edu.pl

Additional information
Attendance to lecture and seminar is mandatory