Module name: Materials selection in engineering design

Academic year: 2015/2016  Code: MIM-2-305-AM-s  ECTS credits: 5

Faculty of: Metals Engineering and Industrial Computer Science

Field of study: Materials Science  Specialty: Advanced Materials - Processing and Characterization

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

Lecture language: English  Profile of education: Academic (A)  Semester: 3

Course homepage: —

Responsible teacher: WRóbel Mirosław (mwrobel@agh.edu.pl)

Academic teachers: Dymek Stanisław (dymek@agh.edu.pl)  dr hab. inż, prof. AGH Krawczyk Janusz (jkrawcz@agh.edu.pl)  WRóbel Mirosław (mwrobel@agh.edu.pl)

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>Connections with FLO</td>
<td>Method of learning outcomes verification (form of completion)</td>
<td></td>
</tr>
<tr>
<td>Social competence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M_K001</td>
<td>goal setting</td>
<td>IM2A_K01</td>
<td>Engineering project</td>
</tr>
<tr>
<td>M_K002</td>
<td>socially responsible behavior</td>
<td>IM2A_K02</td>
<td>Case study</td>
</tr>
<tr>
<td>M_K003</td>
<td>problem-solving style</td>
<td>IM2A_K03</td>
<td>Case study</td>
</tr>
<tr>
<td>Skills</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>M_U002</td>
<td>He/She knows how to use material properties charts developed by professor Ashby to select material for an engineering application</td>
<td>IM2A_U10</td>
<td>Case study</td>
</tr>
<tr>
<td>M_U003</td>
<td>He/She is able to share information and opinions regarding the selection of engineering materials for specific applications</td>
<td>IM2A_U01, IM2A_U06</td>
<td>Participation in a discussion</td>
</tr>
<tr>
<td>Knowledge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M_W002</td>
<td>He/She knows the basic engineering materials, their properties and processing technology</td>
<td>IM2A_W02</td>
<td>Examination</td>
</tr>
</tbody>
</table>
He/She understands the relationship between chemical composition, processing, microstructure and properties of the materials

He/She knows the current state and recent trends in the materials engineering

<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_W003</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>M_W004</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

FLO matrix in relation to forms of classes

Social competence

M_K001 goal setting
- + - + - - - - - -
M_K002 socially responsible behavior
- + - + - - - - - -
M_K003 problem-solving style
- + - + - - - - - -

Skills

M_U002 He/She knows how to use material properties charts developed by professor Ashby to select material for an engineering application
- + - - - - - - - -
M_U003 He/She is able to share information and opinions regarding the selection of engineering materials for specific applications
- + - - - - - - - -

Knowledge

M_W002 He/She knows the basic engineering materials, their properties and processing technology
- + - - - - - - - -
M_W003 He/She understands the relationship between chemical composition, processing, microstructure and properties of the materials
- + - - - - - - - -
M_W004 He/She knows the current state and recent trends in the materials engineering
- + - - - - - - - -

Module content
**Auditorium classes**

Material indices for single constrain and objective. Materials -property bubble charts. Case studies examples related to the modulus-density chart

Material indices for the modulus, strength and density requirements. Case studies examples related to strength-density and strength-modulus charts.

Material indices for the fracture toughness and the loss coefficient requirement. Case studies examples related to the fracture toughness-modulus/strength and the loss-coefficient-modulus charts

Material indices for the thermal, electrical and mechanical properties requirement. Case studies examples related to the thermal conductivity-thermal diffusivity, thermal expansion-thermal conductivity, thermal conductivity-electrical resistivity and thermal conductivity-strength charts

Shape factors in materials selection. Case studies examples related to material-shape indices

**Project classes**

Case studies: materials selection (single constrain and objective). Students’ projects presentation and discussion

Case studies: multiple constrains and conflicting objectives. Students’ projects presentation and discussion

Case studies: material and shape. Students’ projects presentation and discussion

Case studies: process selection. Students’ projects presentation and discussion

Case studies: projects competition. Students’ projects presentation and discussion

**Seminar classes**


Designe process. The design process. Types and tools of design. Materials data for design. Analyse of the designe product function, designe objective, constrains nad free variables. Steps of material selection in designe process. Case studies examples based on M. F. Ashby, Materials Selection in Mechanical Design, fourth edition, ch. 2

Single constraints material selection
Case studies
based on M. F. Ashby, Materials Selection in Mechanical Design, fourth edition, ch. 6

Multiple constraints and conflicting objectives
Selection with multiple constraints. Conflictig objectives
based on M. F. Ashby, Materials Selection in Mechanical Design, fourth edition, ch. 7

Multiple constraints
Case studies
based on M. F. Ashby, Materials Selection in Mechanical Design, fourth edition, ch. 8

Selection of material and shape
Shape factors. Limits to shape efficiency. Exploring material-shape combinations.
Materials indices that include shape.
based on M. F. Ashby, Materials Selection in Mechanical Design, fourth edition, ch. 9

Material and Shape- case studies
Case studies
based on M. F. Ashby, Materials Selection in Mechanical Design, fourth edition, ch. 10

Hybrid materials designing
based on M. F. Ashby, Materials Selection in Mechanical Design, fourth edition, chs 11 and 12

Materials processing
based on M. F. Ashby, Materials Selection in Mechanical Design, fourth edition, ch. 13

Process selection
Case studies
based on M. F. Ashby, Materials Selection in Mechanical Design, fourth edition, ch. 14

Materials and environments
based on M. F. Ashby, Materials Selection in Mechanical Design, fourth edition, ch. 15

Material and industrial design
The requirements pyramid. Product character and personality
based on M. F. Ashby, Materials Selection in Mechanical Design, fourth edition, ch. 16

Forces for change
Market pull and science pull. Marked constraints. Product liability
based on M. F. Ashby, Materials Selection in Mechanical Design, fourth edition, ch. 17

Method of calculating the final grade
Method of the final grade calculating
Final grade=0,49 \( \text{classes, project and seminar grade} + 0,51 \text{exam grade} \)
To pass a min. 60% points for each of the class and min. 60% points for the exam are required
Prerequisites and additional requirements

Prior completion of courses: mechanics, strength of materials, basic crystallography and introduction to materials science is required to participate in this course. Computer skills is required (i.e., PowerPoint, Word and Excell from the Microsoft Office pack or the other equivalents, an internet search engine e.g., Google)

Recommended literature and teaching resources

3. Internet resources

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

8. S. Nowak, K. Żaba, M. Wróbel, M. Kmiecik [et al.], “Wymagania i wady rur zgrzewanych, przeznaczonych na elementy układów wydechowych”, Rudy i Metale Nieżelazne ; 51 (2006) nr 11 s. 663
10. K. Żaba, S. Nowak, M. Wróbel, Analiza przyczyn powstawania przebarwień na powierzchni elementów układów wydechowych wykonanych z aluminiowanych rur ze stali chromowej — Analysis of causes of defects occurrence in a form of a tarnish on surfaces of exhaust system elements made of aluminized steel tubes , Rudy i Metale Nieżelazne ; ISSN 0035-9696., 56( 2011) nr 4 s. 187–195
11. A. Uniwersal, M. Wróbel, S. Woński, Jan Bonarski, Adam Tchorz, Bogusz Kania Porównanie wybranych metod badania porowatości odlewów ciśnieniowych ze stopu magnezu AZ9 - Comparison of selected methods of the porosity testing in pressure die-castings of the AZ91 alloy, Hutnik Wiadomości Hutnicze, ISSN 1230-3534 80 nr 4, (2013), s. 235–241

New papers list: http://www.bpp.agh.edu.pl/

Additional information

None
# Student workload (ECTS credits balance)

<table>
<thead>
<tr>
<th>Student activity form</th>
<th>Student workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination or Final test</td>
<td>2 h</td>
</tr>
<tr>
<td>Participation in project classes</td>
<td>14 h</td>
</tr>
<tr>
<td>Participation in seminar classes</td>
<td>28 h</td>
</tr>
<tr>
<td>Preparation for classes</td>
<td>15 h</td>
</tr>
<tr>
<td>Realization of independently performed tasks</td>
<td>45 h</td>
</tr>
<tr>
<td>Contact hours</td>
<td>10 h</td>
</tr>
<tr>
<td>Participation in auditorium classes</td>
<td>14 h</td>
</tr>
<tr>
<td>Summary student workload</td>
<td>128 h</td>
</tr>
<tr>
<td>Module ECTS credits</td>
<td>5 ECTS</td>
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</tbody>
</table>