Syllabus

Course description

Course title | Summer School “Introduction to Axiomatic Design for the design of complex systems”
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Course code | 43022
Scientific sector | Ing-Ind/16
Degree | Bachelor in Industrial and Mechanical Engineering (L-9)
| Master Industrial Mechanical Engineering (LM-33)
Semester | 2
Year | 2nd, 3rd
Academic Year | 2017-2018
Credits | 2 ECTS
Modular | no

Total lecturing hours | 8
Total lab hours | 
Total exercise hours | 12
Attendance | necessary
Prerequisites | /
Course page | 

Specific educational objectives

The summer school aims at teaching both scientific foundations and practical methods and helps to develop specific professional skills.

Fundamental principles of Axiomatic Design (AD) are reviewed, with insights and perspectives of over 30 years of teaching and practice. This should be of interest to beginners and to all levels of users. The latest methods for using AD, qualitatively and quantitatively, for selecting the best design solutions and for fostering innovations are presented. AD, originating with Nam Suh at MIT in the late 1970s, contends that all good designs comply with two axioms: maintaining independence of the functional elements and minimizing information content. AD can add value and reduce costs in designs and in the design process. Emphasis is placed on techniques for decomposing design problems into valid, corresponding functional and physical hierarchies, and using metrics, to facilitate rigorous application of the axioms. This tutorial is intended design practitioners and students, who might have never used Axiomatic Design, or who would like a fresh perspective.

Lecturer | Visiting Prof. Christopher Brown (Worcester Polytechnic Institute Massachusetts, USA)
The course covers the following topics:

1. Introduction in Axiomatic Design (AD)
2. Domains in AD
3. Customer Needs
4. Functional Requirements
5. Design Parameters
6. Process Variables
7. Constraints
8. Independence Axiom
9. Information Axiom
10. Design Matrix
11. Decomposition and Mapping process
12. Metrics in AD
13. Practical examples and case studies

Case study in the exercise hours: Decomposition of a given or own case study

Teaching format

Frontal lectures, exercises (Exercises, case studies), expert presentations.

Learning outcomes (ILOs)

Knowledge and understanding

1. The student knows the basics of Axiomatic Design,
2. The student knows the current methods and models for the design of complex systems.

Applying knowledge and understanding

3. The student applies and practices theoretical contents through exercises, case studies and project work. Theory contents are practiced through exercises using practical examples.
4. The students develop independently a decomposition of a complex problem.
5. Presentation techniques are trained using equipment such as flipcharts whiteboard.
6. In expert presentations, students have the opportunity to experience and see how Axiomatic Design can be applied to design products or modern manufacturing systems.

Making judgements

7. Depending on the situation in the company, the student can judge the use of appropriate methods, models and systems for the design of complex
systems.

8. He is also able to distinguish between customer needs, functional requirements, design parameters and process variables.

Communication skills
9. The student can make professional discussions on Axiomatic Design and is able to structure, present and argue professional content.

Learning skills
10. The student learns both by frontal teaching (theory part) as well as by exercises in the classroom (exercises).
11. The student is able to enlarge his knowledge through self-study and consultation of scientific and technical texts.

Assessment

<table>
<thead>
<tr>
<th>Form</th>
<th>Length / duration</th>
<th>ILOs assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercises in the lecture room</td>
<td>After each lecture unit</td>
<td>2, 3, 10</td>
</tr>
<tr>
<td>Repeating before each lecture unit</td>
<td>10 min before each unit</td>
<td>1, 5, 9, 10, 11</td>
</tr>
<tr>
<td>Group work</td>
<td>In the exercise hours</td>
<td>1, 2, 5, 8, 9</td>
</tr>
</tbody>
</table>

Summative assessment

<table>
<thead>
<tr>
<th>Form</th>
<th>%</th>
<th>Length / duration</th>
<th>ILOs assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written exam with theory questions</td>
<td>50%</td>
<td>1 hour</td>
<td>1, 2, 6, 8, 11</td>
</tr>
<tr>
<td>Project work during exercises</td>
<td>50% - case studies and subsequent presentation of the results</td>
<td>20 min of presentation</td>
<td>2, 3, 4, 5, 7, 9, 10, 11</td>
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Assessment language English
Evaluation criteria and Final evaluation by a single final grade.
| **Criteria for awarding marks** | The final grade is calculated 50% from the results of the written exam and 50% from the results of the project work performed within the exercises.  
Criteria for the evaluation of the written examination: completeness and correctness of the answers.  
Criteria for the evaluation of the project work/case study: accuracy and completeness as well as creativity and innovation of the proposed solution and quality of presentation. |
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<tbody>
<tr>
<td><strong>Required readings</strong></td>
<td>Lecture notes and documents for exercise will be available on the reserve collections.</td>
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</table>
| **Supplementary readings** | - Suh, N. P. (1990). The principles of design (No. 6). Oxford University Press on Demand.  