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PHYSIC SUBJECTS TO COMPLETE THE BASIC QUALIFICATIONS AND PROFESSIONAL ATTRIBUTIONS FOR THE NEW ENGINEERING AND ARCHITECTURE DEGREES INSIDE THE EUROPEAN HIGHER EDUCATION AREA


Dept. Física, Enginyeria de Sistemes i Teoria del Senyal, Universitat d’ Alacant
Alicante / Spain
Sergi.gallego@ua.es

Abstract

Next academic year 2010/2011 next degrees will begin in the University of Alicante. In particular, in the Polytechnic High School will start 7 new degrees adequate to the “Real Decreto 1393/2007”. Recently Spanish government has described the new legislation to organize the new university degrees according the European Higher Education Area. The recommendations and the laws can be seen in the official Spanish Government publication named “BOE”. One of the main instructions is that the basic subjects must be studied in the first half of the degree with a minimum of 6 ECTS. Taking into account this fact the mobility of the students from one degree to other will be easier. In the University of Alicante Physic subject is an important basic area in Engineering and Architecture degrees. In this sense, in this work we present the project to obtain a common physic subject for each degree. In this project have been participated some of the lectures of the physic of Polytechnic High School in University of Alicante.

Keywords - Curriculum design, European Higher Education Area (EHEA)

1 INTRODUCTION

In the process of adaptation to the European Higher Education Area (EHEA) many changes have been made in the physic subjects. Some examples are: the changing or reforming of the curriculum, the introduction of European Credit Transfer System (ECTS), reformulation of the teaching-learning, etc [1,2,3]. Physics has been defined as a basic subject, thus it is included in engineering and architecture degrees. In the design of old degrees physics subjects have between 10 and 15 credits. Now in the design of the new degrees inside EHEA physic subject has between 6 and 12 ECTS. Last five years we have been working in the transformation of physic subject in order to adequate the teaching-learning and the competencies and conditions proposed by the Spanish government for each degree [4-9]. We have studied these changes in some degrees: Civil Engineering (CE) and Informatics Engineering (IE), Multimedia Engineering (ME), Architecture (A), Building Engineering (BE) and Telecommunications Engineering (TE). In order to achieve good mobility between the different degrees we have designed similar physic subjects. In this sense we have proposed transverse competences for physic subject such as laws of dynamics and kinematics, electromagnetism, etc. In this work to design new subjects we have proposed to take into account some aspects:

- The new competences for each new degree conception.
- The Spanish government’s laws and recommendations [4-10].
- Spanish and European frame for similar degrees.
- The desired professional attribution in each case.

To coordinate our work we have divided our research team in six small networks, one for each new degree with one person coordinating. These coordinators have participated in the University degrees commissions to elaborate the new degrees inside the University of Alicante. The main idea was
defining a basic common physics curriculum in University of Alicante for near degrees in engineering and architecture adapted to EHEA.

2 RESULTS AND DISCUSSION

Firstly we have compared the old subjects to the new ones. As can be seen in Table 1 the physics lectures have been reduced in the new conception of the engineering degrees. Therefore we have to propose new methods for teaching-learning process. In EHEA frame the students have fewer lectures and they have to distribute the time and efforts to achieve the competences required.

Table 1. Physics credits in old and new degrees.

<table>
<thead>
<tr>
<th>Degree</th>
<th>Old Subject</th>
<th>CRÉDITS</th>
<th>New Subject</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Physics I and Physics II</td>
<td>15</td>
<td>Physics I and Physics II</td>
<td>12</td>
</tr>
<tr>
<td>BE</td>
<td>Physics I</td>
<td>12</td>
<td>Physics I and Physics II</td>
<td>12</td>
</tr>
<tr>
<td>CE</td>
<td>Physics I</td>
<td>15</td>
<td>Physics I</td>
<td>6</td>
</tr>
<tr>
<td>IE</td>
<td>Physics I</td>
<td>10.5</td>
<td>Physics I</td>
<td>6</td>
</tr>
<tr>
<td>ME</td>
<td>(New degree in Alicante)</td>
<td></td>
<td>Physics I</td>
<td>6</td>
</tr>
<tr>
<td>TE</td>
<td>Physics I</td>
<td>12</td>
<td>Physics I and Physics II</td>
<td>12</td>
</tr>
</tbody>
</table>

In Table 2 we have presented the competence for the new subject in the six analyzed degrees. It is important to remark that the new competences related in Spanish laws are similar than the old ones. Some of these new degrees have started in other Spanish Universities. Our work consists in to analyze the similarities between each degree, after we can propose the new subject to complete the basic qualifications and professional attributions for the new engineering and architecture and to obtain a common physic subject for each degree. As can be seen in Table II many of the competences are included in different degrees.
Table 2. Competences published in official Spanish Government publication “BOE”.

<table>
<thead>
<tr>
<th>Degree</th>
<th>Competences</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Principles of mechanics, static, vector fields, thermodynamics, acoustics, optics, fluids, hydraulics, electricity and electromagnetism, applied to architecture</td>
</tr>
<tr>
<td>BE</td>
<td>Theoretical and basic concepts of mechanics, static, elastic solid behaviour, thermodynamics, acoustics, fluids, hydraulics, electricity and electromagnetism, applied to BE</td>
</tr>
<tr>
<td>CE</td>
<td>Principles of mechanics, thermodynamics, fields, waves, electromagnetism to solve questions applied to CE.</td>
</tr>
<tr>
<td>IE</td>
<td>Basic concepts of fields, waves, electromagnetism, DC and AC circuits, physic principles of semiconductors, logic families, electronic and photonic devices to solve question about IE.</td>
</tr>
<tr>
<td>ME</td>
<td>Principles of mechanics, thermodynamics, fields, waves, electromagnetism to solve questions about ME.</td>
</tr>
<tr>
<td>TE</td>
<td>Principles of dynamics, kinematics, waves, DC circuits, signal processing, and the application to TE</td>
</tr>
</tbody>
</table>

In order to obtain a deep insight about common descriptors and competences we have presented Fig. 1. There are some drawbacks to keep a common base in physic subjects. We have tried to find almost 70% of common contents in the subject. In Fig. 1 it can be seen as some items appear in every degree. Waves and electric field (electromagnetism) can be used to design the base of the future physics subjects. Other subject descriptors, as dynamics and kinematics, can be found in the 67% of studied degrees. Some of specific descriptors only appear in few degrees such as photonic displays. These specific descriptors are given by the Spanish legislation.

Fig. 1. Percentage of common descriptors among the subjects of Physics.
As can be seen in the official Spanish Government publication named “BOE” [4-9] Physics is an important subject to complete the basic qualifications and professional attributions for the new engineering and architecture degrees inside EHEA. To teach this new subject we have fewer lectures, and the lectures have been divided in three different categories: theoretical, practical exercise and practical experiments. University of Alicante have proposed groups of 100 students for theoretical lectures, and for practical exercises and practical experiments 15 students per group. The learning time is divided also in two parts: the time employed by the student with the lecturer and the time used by him self to study. In previous woks we have analyzed the time employed by student in each activity [10]. In Fig. 2 we present the proposed time for Physic subjects divided by activities. For all subjects “presentiality” (P) time or working time guided by lecturer, is 60 hours, while “non-face” (N-F) time or time of autonomous work of students is 90 hours.

As we have commented in Table 1 the lectures subject have been dramatically reduced. This reduction is more important fort the practical experiment in the laboratory. Due to reduction we have to redesign the method to teach in order to achieve the competences proposed. In this work we have proposed some models: b-learning model, e-learning model, practical-research, etc. One interesting idea analyzed is spend the time in very specific degrees practical experiments, but taking into account the common basic concepts among the Physic subjects.

About the transversals and professional attributions we want put emphasis in some aspects:

- Ability to work in groups.
- Ability to schedule tasks and engage in meeting targets and deadlines.
- Ability to oral and written exposition.
- Ability to adopt the scientific method in the planning and carrying out various jobs in both academic and professional.
- Ability to self-criticism and analysis needed to improve the quality of a project.
- Ability to assimilate and adapt to the continuing evolution of technology in the field of professional development.

![Fig. 2 Time distribution (in hours) for each Physic subject, presentiality (P) and “non-face” (NF) time.](image-url)
3 CONCLUSIONS

In this work we have achieved a deep insight in the near new physic subjects adapted to EHEA. Physic subject plays an important role in the first semester of new degrees. In order to improve the student mobility, we have studied the viability to obtain common Physic subject in engineering and architecture degrees in University of Alicante. We have discussed as the “non-face” students time is an important parameter to achieve the goals in the new education method conception. Furthermore we have proposed some qualifications and professional attributions interesting for the new engineering and architecture degrees.

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References


