FSES, the developed UES which is aimed at developing required competences in metrology and certification is of significant practical value.

Moreover, within the framework of university development plan implementation and the Arctic cluster orientation, the UES makes it possible to identify quality features of the products offered by the northern enterprises with due regard to environmental, ethnic, economic, and other characteristics of northern (Arctic) region. This allows graduates to carry out essential comparative analysis of the certification criteria used in the Arctic countries and national certification systems paying special attention to environmental issues.

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UDC 378

Curriculum Design in Engineering Education and the Role of Partnerships

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Engineering schools have to be aware of three important levels of profile analyzing to guarantee the employability of their graduates: The local market needs in skills, the companies needs in human resources technically, the international openness and importance of partnerships and patronage activities. At Esprit, these three points are considered as key-metrics to design the curriculum in engineering education.

Key words: teaching, learning, design, curriculum, engineering, assessment, market needs.

1. Introduction. When it is about seeking what skills fit the new jobs required in every country, it's a whole ecosystem behind that, we have to review and study deeply. We cannot mention the market needs in skills, soft and technical ones, without talking about its needs in human resources. Do the companies require specific technical competences, certified engineers, specialists, excellent products sellers... These are the questions the engineers' schools boards ask frequently. Companies' needs in engineers doesn't only concern the local market but the international one too. We will try to explain how these three components are the basics to design a flexible curriculum in engineering education.

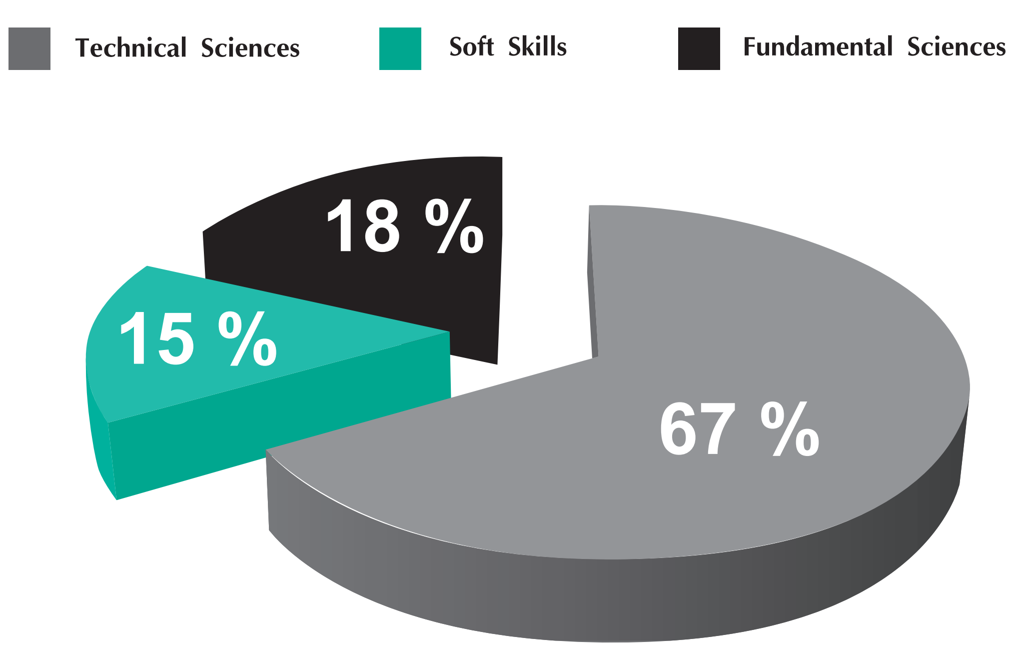
2. Local market need. What enterprises managers seek when they want to hire engineers vary from a period to another depending on the economic and political status of the country. Which fields are more important than the others and in which competences we have a lack in are the most important ways of measuring how to grow the company. Let's take for example the IT domain, simply, we can say that as it is empowering every field and always useful, it never dies as an important tool to make services more and more automatic and faster. For the case of Esprit, the best private engineering school in Tunisia, we don't only reform the learning curriculum but the whole university environment to let each entity play its role to constitute this mosaic of ecosystem to keep leading and graduating the best of Tunisian engineers among public and private universities. In fact, we learn a lot on the study of the existing solutions in the local market to inspire teachers choosing the best case-studies to guide students in every level during their engineering studies to be able to develop in their own ability for solving problems and here we can talk about the Problem Based Learning (PBL) concept which is the basic and most important step in designing the curriculum by adopting the active pedagogy. We mean by this way of teaching that students, by time, become able to detect the specific needs technicality of the enterprises in skills that can contribute in developing solutions that can ameliorate the entire economical chain in every industrial domain. So if we prepare engineering students think problem-solution, we'll obtain a very constructive way of thinking and operating in the professional market. At Esprit, and since the 1st year of studying, we push the new generation to think differently by bringing innovative ideas and pitching them in front of experts in entrepreneurship. So we don't prepare them only to be engineers who will look for a job but also to have entrepreneurial spirit where the target becomes creating jobs. ESPRIT has reformed its curriculum by adopting a teaching strategy mostly entrepreneurship-driven. This approach has led the university to fit with the international standards [2] in the term of teaching soft skills like management and marketing using active pedagogy while respecting the number of credits (15% of the curriculum) [Fig.1] required by French CTI (Commission des Titres d'Ingйnieurs) which allowed ESPRIT to become officially accredited by EURACE last year (June 2014) [3].

The launch of an academic incubator is the most important proof that Esprit is working continuously on designing the whole university environment and not only the curriculum. This incubator select, in a collaboration with the engineering school board, the best of the best of project ideas owners with ready business plans to help them by mentoring them till the creation of their start-ups.

3. Companies' needs. To prepare good profiles for good jobs and despite the good percentage of its working Alumni [Fig. 2], 72% of its graduates are active in medium and big enterprises [3], Esprit has a Learning Factory that the students can integrate during the last year of their studies to do their capstones' internships by developing their end of year projects from the design level to the test and validation of the solution.

This Learning-Factory is just near the campus and composed by 12 partners companies of the engineering school. These companies by involving students in some projects of theirs to develop, they allow to the university to detect more specifically the needs in human resources and train the future engineers to get in the professional environment easily. These internships prepare students not only by coaching them in technical skills but also on the soft one like interpersonal and communication ones.

Fig. 1. Modules by Category

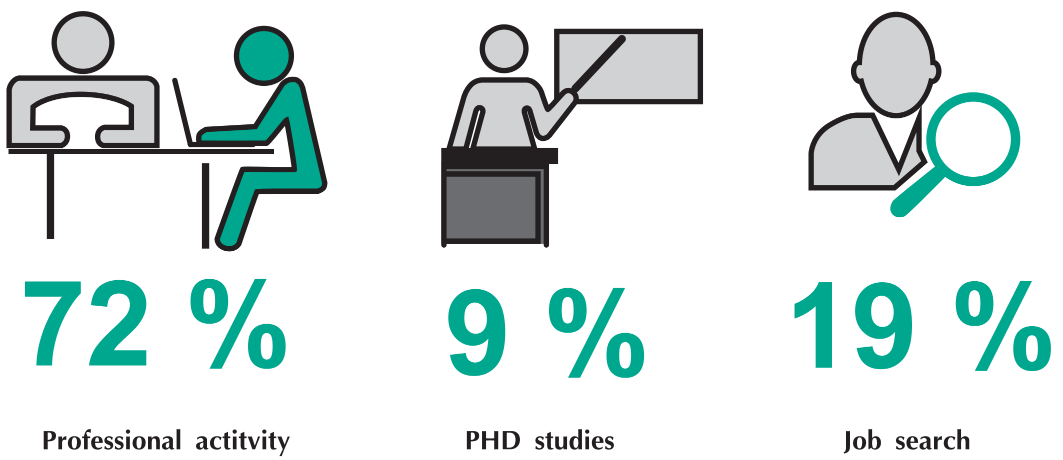


4. International openness. Esprit has many partnerships with universities all over the world. There are different forms of collaborating to insure the international openness to face the economic crisis of the country. Research is one of the most important keys to empower the teachers' staff ability in following the technological progress worldwide.

Esprit-Tech is the Research, Development & Innovation (RDI) entity of the university that is constituted by many teachers in many research fields who supervise students either in enterprises or in other universities partners. The objective behind this procedure is to develop their academic projects till their graduation.
The curriculum is well designed with such an elasticity that allows future generations of engineers to be multipurpose, multitask and aware of the incredible fast rhythm of progress in the technology domain.

5. Conclusions. In front of all these details hidden behind the pedagogical and academic aspects of Engineering Education, it is primordial to build some roots of the university with the enterprises locally and also at the international scale. That's why we cannot stop at innovating and designing curriculum without reforming the assessment methods measuring the learning outcomes. We've mentioned previously the PBL method and even the project validation but in Esprit, it is not only a question of obtaining marks but also to push engineers to participate to national and international challenges to value their efforts and competences. This challenge spirit begins with the validation of the academic realizations in an ambiance similar to the real one outside the school.

Fig. 2. Graduates' status



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Shaping the Professional Competences of Undergraduates in Engineering Universities, Illustrated By the Investigation of Gas -Turbine Surface and Blade Via Its Axonometric Drafting

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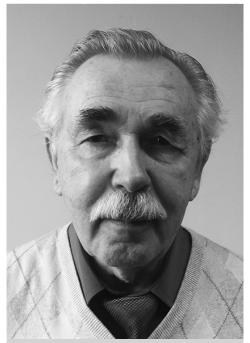

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The article describes a course example "Research-Graphic Practicum" oriented at reinforcing previous knowledge and skills in "Engineering Graphics" and further development of professional competences of undergraduates based on the illustrated investigation of the gas-turbine blade. The authors formulated assignments in designing a theoretical model and executed an axonometric draft of the gas-turbine vane.

Key words: engineering education, engineering graphics, gas-turbine blade, competences.

Introduction

One of the major requirements imposed on an engineering university graduate is professional competences. Professional competences embrace advanced knowledge level and cumulative achievement of both general professional and specialty courses. This means that in the beginning of prevocational education, a student should be able to execute theoretical models, projecting physical phenomena and understand how to apply them.

The shaping of such a competency is illustrated by the investigation of gas-turbine unit surface and blade including further axonometric drafting of the blade itself. This article describes the practical modeling of a gas turbine blade based on the gained knowledge through descriptive geometry and axonometric projection modeling rules. Surface 3-D model type based on three plotted blade plane sections was analyzed and the axonometric projection of this space blade was described. This research was conducted by undergraduates of the Power Engineering Faculty, Moscow State Technical University n.a. N. E. Bauman.

Ruled surface

Hands-on experience with ruled surfaces involves specific details of a gas turbine unit – a blade.

In this case, a ruled surface is precisely determined by 3-directional lines. Arbitrarily, there are only two directional lines. The position and configuration of the third directional line is selected so it would be within the "body" configuration itself, which, in its turn, is determined by the data of two other directional lines, i.e. two directional ruled surfaces determine the third plane.

Based on the spatial directional line configuration and position dependence a surface is derived. In this case, five types have been defined:

1. Standard surface configuration (oblique cylinder with 3 directional lines) is formed in straight-line motion involving three curvilinear directional lines (Fig. 1).
2. Double-oblique cylindroid surface is formed in straight-line motion along two directional curves, while the third is a straight line (Fig. 2).