050
A View on Electrical & Computer Engineering Education:
Challenges toward convergence of different disciplines

G. A. Kyriacou
Professor
Department of Electrical and Computer Engineering,
Democritus University of Thrace,
GR-67100 Xanthi, Greece,
gkyriac@ee.duth.gr

Conference Topic: The Challenge of 2020: Issues and Actions
Keywords: Convergence of Scientific disciplines, rigid background versus specialization

It is well established that the duration of engineering education requires at least five years in order to establish the required background for handling both practical problems as well as to be ready for a research carrier. The political elite in Europe in collaboration with the industry has adopted the Anglo-Saxons' model of the split three years Bachelor degree and one two years Master degree. However, the Academic community in full agreement with the Engineers Professional organizations seems convinced that the best Engineering education should be based on an integral five years curriculum, considering the adopted model as leading to dispensable young Scientists. The weakness of this latter thesis is that most five years Engineering undergraduate programmes include at least one year (usually three semesters) of specialization. One could claim that this makes the curricula somehow split into two circles, hence similar to the accepted Bachelor-Master approach. The argument against this view is that the "integral five years" path can be setup in a more controllable way so that the specialization is build on rigid bases. To these different point of views must one should add the recently realized necessity of the required "Convergence of Engineering, Physical and Health Sciences" in order for engineers to advance the technology beyond the current borders and especially regarding novel diagnostic – therapeutic techniques and health services, [1]. Besides that it is now a common understanding that a modern engineer must establish a rigid theoretical background and not just a restricted knowledge specialization, so that he/she will be able to adapt to the fast varying of technical environment with a high rate of newly introduced plethora of specializations.

In view of the above, the question is whether the newly reformed Electrical & Computer Engineering in Greece are able to successively respond to these challenges. If they can't what are the reasons, is it possible to overcome the obstacles and how? If we do accept that a rigid theoretical background is necessary, what will be the content of the corresponding mandatory curriculum? If we do agree that "an integral five years engineering education" is needed, what are the means to be used for convincing the political elite and the industry representatives?

The above questions constitute a serious problems and they cannot be addressed in a single paper. The intend of the Author is to systematically put down the questions in some logical order and the ambition is directed toward addressing some of them from his own point of view and experience.

A wide consensus of the Engineering community and boards is observed in regard to reforming engineering curriculum toward:

i) De-emphasize narrow disciplinary approaches and strengthen thought along inter-disciplinary lines. Utilize a problem – solving approach to support this task.
ii) Retain and possibly strengthen a solid basic engineering knowledge. The report [5] even suggests the adoption of a 4 years core courses plus 1 year specialization in the integral 5 years professional (M. Eng.) degree.
iii) Educate engineers to work better in groups and the best way is through the problem solving based learning.
iv) More emphasis should be put on design and not to be restricted in the analysis. Namely, to strengthen the students hands-on engineering experience as "design-build-operate". This means not only to enhance the laboratory exercises but to carefully select problems from the real world-industry applications within the PBL approach.
v) To include courses on economics, marketing and management in the curriculum, which will improve engineers employability but also strengthen their skills toward solving interdisciplinary problems and improve communication when working in teams.
vi) Prepare engineers to act as policy makers and leaders by including courses on Ethics and public policy, [6]. These courses may contribute to the realization of legal and moral responsibility of Engineers in their professional practice.
vii) According to [5] try to "Infuse more professional content into existing engineering programmes". This is already adopted by MIT and Stanford through the appointment of Engineers with distinguished carriers in industry as *"Professors of Practice"*.
viii) Prepare engineers for lifelong learning or one could say "teach them how to learn and they will carry on to acquire more knowledge than their educators". Keeping in mind the above and using them as guidelines, we will try to suggest the first steps of the required undergraduate curriculum reforms.

It is widely realized that engineering education faces a substantial change trying to address the economy globalization as well as the interdisciplinary sciences convergence. Solid engineering education must be retained, while during their education they must acquire hands-on experience in *"design-build-operate"* through projects. Additionally, engineers must be prepared to become leaders and policy makers thus they should have knowledge of basic economic, marketing and managerial topics enriching their "soft-skills" or communication abilities. Some first steps toward enhancing the Greek EECE curriculum have been proposed herein for both core and specialization courses. Two are the major challenges, to include project-based learning through the entire curriculum and to adopt a number (14) flows – flows in the specialization able to support the evolving convergence of sciences but before all to support the engineering diploma equivalence to a Master of Engineering degree. Finally, a cooperation call is addressed to all colleagues and in particular to SEFI leadership to support our claim to Greek government and the European Union for a recognition of all integrated systems engineering diplomas as equivalent to a Master of Engineering (M. Eng.), provided that they have undergone the appropriate accreditation.

REFERENCES

[1] MIT white Paper, *"The Convergence of the Life Sciences, Physical Sciences and Engineering"*, available online www.cimit.org/.../MIT-White-Paper-on