



A Dynamic Educational Planning for Education of Electrical Engineers in E.E. Department of Sharif University of Technology

Mehdi Vakilian, Forohar Farzaneh, Mehdi Fardmanesh, Mehdi Ehsan, Mahmoud Tabandeh, Mahmoud Fotuhi, Mehran Jahed, Mohammad Haeri, B. Hossein Khalaj, M. Hossein Alavi, Mahmoud Nahvi

Electrical Engineering Department, Sharif University of Technology

Azadi Avenue, Tehran 11365, Iran

ABSTRACT

In 2004 a decision was made to assign a special committee to review and evaluate the existing undergraduate program in the Electrical Engineering Department of Sharif University of Technology in accordance to the professional needs of the graduate engineers in the related industries, as well as the potential required for those graduates to continue their studies internationally in the highest level possible. Finally after a major review of the educational structures of the advanced universities around the world, and study of the national industries requirements, in April 2007 a new educational program developed by this committee was approved in several stages in the educational board of Sharif University of Technology and next in the Ministry of Science, Research and Technology for implementation from September 2007. The first students studied under this program will graduate in July 2011. In this paper first the goals of this department, which were reviewed by this committee, are presented. Based on these goals, the specific principles are developed, for the undergraduate educational planning. Consequently the structure of the new program are presented and discussed. Finally the methods employed for evaluation of this educational program are presented and the preliminary results of some of the scheduled evaluations are presented.

Keywords: Educational Planning, Restructuring the Educational Program, Electrical Engineering, Dynamic Educational Planning

1. INTRODUCTION

The Advancements of recent two decades and the new developments in some aspects of educations required by engineers, realizing the merging of new computational technologies and evolution of production and manufacturing techniques resulted in a worldwide restructuring in the educational programs and tools employed in engineering education. This resulted in substantial modifications in the education structure of many advanced universities around the world which are studied and discussed in the process of this educational planning [2,3,4,5,6,7,8,10,11,12,13,14,15,16,17,18,19,20,21].

These worldwide advances in modern educational techniques were acknowledged by academic faculty members of the Electrical Engineering Department in Sharif University of Technology who have employed those in the development of the new educational program in a manner to be coordinated with the specific requirements of the industries in the country. Therefore a goal is set to renew and update the content and the structure of the undergraduate electrical engineering educational program of the

Sharif University of Technology, to be harmonized with the programs of the advanced universities in the world, and to respond effectively to the requirements of our industries.

A committee (made of about 12 faculty members of the department) was assigned for this purpose by the Electrical Engineering Department. This committee first defined the mission and the goals of the department, and based on that the new educational program is developed. Meanwhile, in our country and many other countries that the industries do not have special educational programs for new employed engineers, still different fields should be offered under Electrical Engineering for under graduate education [22].

In the next section, the goals of the department will be presented briefly, and based on that the main principles in development of the new undergraduate educational program will be presented in the following section.

In the fourth section the structure of the new program, the related fields of study, and the semesters structures are presented briefly.

In the section five of this paper the methods employed in implementation of this dynamic educational planning will be reviewed briefly.

2. GOALS

A brief review of the goals are presented in the following:

- (a) The development of an update educational program in highest international level
- (b) Education of professional electrical engineers to carry on the analytical, design and research works in any related industry and to achieve the ability of leadership, creativity, and entrepreneurship in their profession under a sustainable development structure
- (c) To educate the graduates in a superior level coordinated with progresses in science and technology
- (d) To develop the required basis for graduates' to continue their studies in towards higher levels
- (e) To develop the required background for growth and boom of scientific talent
- (f) Scientific and technical promotion of the University and industries in the country
- (g) Development of a continuous learning ability during the life
- (h) To intensify the self confidence in solving industrial problems and development of independent technical and scientific thinking
- (i) To admit outstanding students, faculties and staff to achieve the progressive professional goals



- (j) To improve and intensify the interrelation of faculties with their colleagues and students in the advanced research institutes outside the department and the university
- (k) Improvement of electrical engineering profession to serve the society
- (l) Education of professional personnel with the required managerial and technical skills
- (m) To present guidance and take part in scientific and technical strategic decision making and solving industrial problems
- (n) Responding to the scientific and industrial needs of the country
- (o) Having an active participation in science production and advanced technology progress

3. PRINCIPLES

Based on those general goals of the department, the goals of the undergraduate electrical engineering educational planning are developed by this committee, as follows:

- (a) Planning the start of this educational program from the first semester the student enters the program.

This approach helps the students to improve their point of view about the electrical engineering and to gain a deep understanding of the related principles and concepts which will establish a strong foundation for effective learning of the required skills in the field of Electrical Engineering.

In the past program, the first year student, without having a proper idea and understanding about the principles and applications of his/her field of education were engaged with different courses in physics and mathematics which were completely uncoordinated with their expectations and goals in choosing this field of study. On the other hand this process may confuse the students who are interested in theoretical fields not the electrical engineering.

- (b) Courses developed on a laboratory basis

This helps the students to understand and identify deeply the different areas and major concepts in field of Electrical Engineering. The laboratory schedule is coordinated with class topics so that the topics taught in class can be investigated practically through experiments in the laboratory. Thus, the students will understand and learn satisfactorily the theoretical concepts of Electrical Engineering.

This will help students to learn the related theoretical principles deeply and consequently helps us to educate creative and progressive engineers in Electrical Engineering who have a strong theoretical background in Electrical Engineering.

This is one of the advantages of employing this principle, and lack of this kind of courses may cause educating engineers who are not equipped with the professional capabilities and skills expected from an electrical engineer.

- (c) Combing some of the courses

As discussed in item (a); in the first two semesters of the new program students have courses in electrical engineering. Consequently, some of the

classic courses of the past program (in the second year) and specially some of the common core courses are combined to develop a new and advanced course. This strategy improved the courses effectiveness and minimized the review of same materials, repeatedly, in different courses when it is not necessary. Also this strategy released some spaces to be used for planning some necessary courses in area of management and economics for electrical engineer students.

- (d) Planning some new courses to satisfy the new technical and industrial requirements for education of an electrical engineer

(e) To present a minimum number of courses in the management and economics in this program to help these graduates in establishment and management of independent engineering companies, entrepreneurship, and tenure the managerial positions in different organization they will be engaged in after graduation.

(f) To improve the quality of the under graduate senior projects. This course is scheduled in two semesters. In the first semester students participate in a class and will be taught the standards of professional presentation, and writing professional reports and papers. In this semester, also student (under the supervision of a project adviser) will prepare a proposal for his/her undergraduate project and present it in the class and its related time schedule to be followed in the next semester (as the approved schedule of the project two). And in the second semester the student implement his/her proposal according to its time schedule under supervision of the same project adviser and at the end presents his outcome in the class and submit a professional report for his / her project.

(g) Improve the industrial training for the students in this program by effective scheduling of the training through coordination with frontier industries in the country and abroad to develop a realistic approach about the industries and the work place in the country and lead the student to plan a proper path for his/her future work or continuation of his /her studies.

(h) Planning a course to teach students the fundamentals of engineering ethics in order to develop a safe work place which provides an environment of mutual confidence for engineers' interactions. Any ignorance towards this subject can lead to substantial problems in future of our graduates' professional careers in establishment of any contract with customers, or their colleagues, while it can also hamper the progress of the industry.

(i) To teach the principles harmonized with the environment and against its destruction besides the item (h) helps our graduates to investigate the consequences and impacts of their designs and implementations (in any industrial project) on the environment and to minimize the destruction of the environment.

(j) To devote a higher portion of the program to specific fields in electrical engineering (the last three semesters). Therefore in the sixth semester the students are introduced to their field of interest and in the seventh semester the student proposes the project of his/her interest and concludes the work on the project in the eighth semester. Through these projects each student develops a strong background for his/her future work or continuation of



his/her studies.

(k) Revising and updating the theoretical contents (and the educational assistance software) of the courses besides planning and implementation of coordinated group courses with different lecturers, when in one semester a course should be delivered in two to five groups. This coordination will guarantee the coverage of the scheduled contents of the course and improvement in the education quality, especially in the common core courses. They need a common order and schedule for the presentation of these courses (in different class sessions and different laboratory sessions), specially to have common midterm and final examinations.

4. STRUCTURE

The new structure of the undergraduate program is divided into two main sections. In the first five semesters the students are taught the common core of electrical engineering program that is 99 credit hours out of the total of 140 credit hours. At the end of this section student can select his/her field of concentration out of one of the six fields, named as: Bioelectric, Controls, Digital Systems, Electrical Energy Systems, Electronics, Tele-communications.

In this second section 41 to 42 credit hours are planned in which students are taught 24 to 26 credit hours in their field of specialties and 6 credit hours from the other field of Electrical Engineering and 3 to 6 credit hours from management and economics courses, one credit hours in engineering ethics and environment, 3 credit hours of undergraduate projects one and two and a two credit hours in general education course.

One of the important advantages of the new program is the existence of seven 4 credit hours courses delivered in conjunction with laboratory in the common core section of the program and introduction of new laboratories, as shown in Tables 1 and 2. Another advantage of the program is the revision of some engineering courses such as numerical computation, Mathematics one and two, Physics one and two, Engineering Graphics, Printed Circuit Drawing and Electrical Engineering Drawing.

In Table one the structure of the first three semesters of the common core section of the program are shown.

And in Table two the structure of the semesters four and five of the common core section of the program are shown.

Managing the common core semesters in five semesters, there would be three semesters to be used for each of the six special fields in the program. And especially the students will have enough time to establish and enforce their understanding of the special field of their interest in the sixth semester and then they have two last semesters to spend on their undergraduate project in an efficient pace.

Table One: Structure of First Three Semesters of Common Core

First Semester	Units	Second Semester	Units	Third Semester	Units
Mathematics I	4	Mathematics II	4	Electric Circuits Theory	3
Physics I + Lab.	3 + 1	Physics II + Lab.	3 + 1	Engineering Mathematics	3
English Language	3	Differential Equations	3	Numerical Computation	3
Physical Education 1	1	Computer Programming & Algorithms	2	Elect. Eng. Specialized Language	2
Engineering Graphics	2	Physical Education II	2	Electro-Magnetics	3
Fundamentals of Electrical Engineering + Lab.	4	Analogue Circuits + Lab.	4	Fundamentals of Electronics + Lab.	4
General Education	2	General Workshop	2	Electrical Engineering Workshop	1
Total	20	Total	20	Total	19

Table Two: The structure of Semesters four and five

Fourth Semester	Units	Fifth Semester	Units
Signals and Systems	3	Communication Systems	3
Electrical Energy Conversion I + Lab.	4	Computer Structure and Microprocessor + Lab.	4
Logical Circuits and Digital Systems + Lab.	4	Linear Control Systems + Lab.	4
Engineering Statistics and Probabilities	3	Analysis of Electrical Energy	3



		Systems I	
General Education	2	Engineering Economics	3
General Education	2	General Education	2
Total	18	Total	19

Table three demonstrates the number of credit hours devoted to different scopes of education in the common core section of program.

Table Three: Share of different scopes in C.C.

Electrical Eng. Core	55 Units
Basic Sciences	30 Units
General Education	14 Units
Total	99 Units

The structure of whole curriculum, demonstrating the credit hours devoted to different disciplines, is shown in Table Four.

Table Four: Structure of whole Curriculum

Electrical Eng. Core	55 Units
Basic Sciences	29 Units
Compulsory EE Courses for a Specific Field	24 Units
Elective Courses from EE, Management & Economics	12 Units
General Education	20 Units
Total	140 Units

Table five demonstrates the structure of whole curriculum in a glance.

Table five: structure of whole curriculum

FRESHMAN	SOPHOMORE	JUNIOR	SENIOR	Total
Fund.EE 4	Eng.S.&P. 3	Energy S.A. 3	Eng. 1	Eng. 1
Math.1 4	Log. CCT. & Dig.S. 4	Telcom. 3	Ehics 3	Ehics 3
Phys. 1 4	E. Conv. 1 4	Comp. S.L. & Mic. 4	E.L.M.E. 3	E.L.M.E. 3
Eng.Dr. 2	Sig. & S. 3	L. Con. Sys. 4	E.L.E.E. 3	E.L.E.E. 3
Eng.L. 3	Num. 3	Elec. 1 Work. 3	E.L.F. 3	E.L.F. 3
Physical E 1	Comp. 3	Gen. E 3	E.Lab. 1	E.Lab. 1
Gen. E 2	E. Lang. 2	Gen. E 2	Gen. E 2	Gen. E 2
	Physical E 1	Gen. E 2	Proj. 1	Proj. 1
		Gen. E 2	Ind. 1	Ind. 1
			0	0
Total 20	Total 20	Total 20	Total 13	Total 14

Total No. of Units: 140

C.I.F.: Compulsory in field
 E.L.F.: Elective Course in field
 E.L.E.E.: Elective course in Electrical Engineering
 E.Lab.: Elective Laboratory
 E.L.M.E.: Elective course in management & economics

5. IMPLEMENTATION

There are several major tasks in implementation of the new program. Preparation of new laboratories to be coordinated with progress of the course and to be able to deliver the laboratory for a group of 30 to 40 students per laboratory session where, students should work in groups of two. This required substantial efforts from the faculties and also to provide the necessary investments. Examples of these laboratories are the Electrical Engineering Fundamentals laboratory in one extreme which required an extensive amount of planning session and workshop efforts of some of the faculties with relatively lower investments and in an advanced structure comparable with best laboratories in the world. And Electrical Energy Conversion one, located in the other extreme, therefore it required a reasonably less planning efforts, however required a relatively extensive efforts for development and production of the equipments and measurement tools which practically took about three years to become in full operation. The other five laboratories were in between.

Development of new course outlines, new time schedule for presentation of the courses, the new assignments, quizzes and examination strategies were elaborating tasks from one point of view, however enjoyable for all



of the faculties engaged to see their graduates will be update. This had a transient duration of almost three years for the common core courses. While, the transients of special courses in the fields have a relatively smaller duration.

Since every year about 200 new undergraduate students (which are among the first five hundred ranks of the country wide undergraduate entrance examination of all Universities in Iran) are admitted to this department, and a standard of (at most) 40 students in a class is followed in our new planning, it is required to have between 2 to 5 classes for the common core courses in each semester.

However it is required and recommended that these sessions should be coordinated which is an important to guarantee the complete coverage of the topics required and to improve the quality of these courses. The classes of these courses at least have one mid examination and one final examination together, in which the questions are designed through cooperation of all lecturers in that semester.

6. EVALUATION

Since every program needs to be under evaluation and continuous revision, the committee considers several methods for evaluation of this new program especially in its implementation.

These employed methods are as follows:

- (a) Questionnaire for students after first course and second course in electrical engineering, after second year, after third year and at graduation
- (b) Through questionnaire prepared for lecturers or through organizing meetings with lecturers to discuss about results of implementation of specific common core courses
- (c) Questionnaire for industrial experts (should be planned in future)

An example of questionnaire for the second course in electrical engineering is shown in Table six (however, just six questions out of the total of the eleven questions that required selective answers are shown, and there was also the 12th question that required a descriptive answer about the course).

Table Six: Example of Questionnaire for Analogue CCTs & Lab.

Question:	Completely Agree	Agree	Neutral	Completely Against	Against
1-This Lab. Helps me on learning the subject	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2-This Lab. Improved my interest on subject	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3-The concepts and expertise delivered by this lab follow the class teachings	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4-This Lab. helps me on practical & critical thinking on the subject	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5-The experiments of this Lab. are clearly related to topics of the course and electronic devices & circuits	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6-Lab. supervision by class professor helped my learning the subject	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

This course is delivered in second semesters for the students and during this questionnaire four groups were delivered. In that semester one of the lecturers was responsible for the website of the course, another one was responsible for organizing the course assistants of tutorial sessions and laboratory sessions. And another lecturer was responsible for the preliminary preparation of tutorial questions and the next was responsible for weekly meetings of the lecturers to discuss the performance of their classes and to consult their experiences together. This first questionnaire was distributed after about one and half year of the start of the program

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تهران، دانشگاه صنعتی شریف، ۸ و ۹ آبان ماه ۱۳۹۲



from about 150 students of these four groups. The answers to the questions from the four classes are collected. Considering values of one to five for the digital answers to the questions of this table (i.e. completely agree=5, and against=1), the average of these answers was close to 4 out of 5. This shows that the students answered the questionnaire are in a good agreement with the method the course was delivered. However, the descriptive answers to question 12 contained some suggestions for improvement of the laboratory, regarding the number of assistants in the laboratory, and the number of experiments in each session of the laboratory that could help the lecturers and other faculty members to rectify those problems in the next semester.

Another questionnaire distributed (in April 2010) after about three years from the start of program for the students entered in 2007 and the students entered in 2008 which demonstrated a very satisfactory point of view in general from the whole program however, it also helped the committee to improve the contents and the methods of implementation of the program (after organizing special sub-committees to investigate the reasons for the un-satisfaction of the students in those courses or laboratories) in some of the common core courses.

The educational planning committee, in this year also (in May 2011) distributed another questionnaire for students entered the undergraduate program of the department in 2007, who are graduating in July of this year. It is expected that the answers to this questionnaire will further help this committee to rectify any possible shortcoming in the program and to improve the program and its implementation method in a dynamic form.

7. CONCLUSION

In this paper the principles of the new undergraduate educational planning in Electrical Engineering Department of Sharif University of Technology, realizing the goals of this department based on its mission and after study of the update programs of Electrical Engineering Departments of advanced universities around the world are presented. A committee was assigned in this department in 2004 to develop the new undergraduate program through a substantial restructuring in the past program. The assigned committee (combined from 10 faculty members and two expert consults) developed the new undergraduate program in February 2007, after three years of continuous work on the subject. Subsequently, the new program was approved by Ministry of Science, Research and Technology in April 2007 for implementation. The implementation started from September 2007 and the first group of graduates studied under this new program will be graduated in this July. The educational planning committee of this program continued its work through monthly meetings and organizing some sub-committees as necessary to guarantee the update and dynamic characteristics of this program. This restructuring was the first in the country and many universities in the country are planning for similar restructuring in their undergraduate educational planning, in close future.

The evaluation of the new program in different stages as discussed in section 5, demonstrated a relatively satisfactory structure and implementation, however a continuous improvement in different aspects of the program are required in future.

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