

## INNOVATION IN ENGINEERING EDUCATION

*Claudio da Rocha Brito<sup>1</sup>, Melany M. Ciampi<sup>2</sup> and Ricardo C. Molina<sup>3</sup>*

**Abstract**— *SENAC School of Engineering and Technology has conceived and developed the Telecommunication Engineering program, which contains in its curriculum the "free period". It is called so because it is a time the students have to attend classes in the several other areas of knowledge, in one of the Units of SENAC. They are free to choose among the many options like environment issues, nursery, photography, design, fashion, languages, art, etc. the choice is up to them. They can choose as many areas as they want along the five years, at least one per two years. At the end of each period they have to present a report about their development. The report is showed and discussed with a council compound of a psychologist, a pedagogue an engineer professor and the coordinator of the program. Besides they have the basic science courses, basic engineering courses and specific engineering courses.*

*Index Terms*  $\mathcal{A}$ Free Period, Human dimension, pedagogy, and telecommunication.

### INTRODUCTION

The challenge in Brazil, like any other Country of West World is to form professionals with scientific minds to develop science and technology in according to the complexity of modern day-by-day life. Science and technology has to promote the progress of contemporary society drawing a complete new future. It is essentially, to make science and create technology in according to the necessities acting locally, thinking globally.

People live in a world of no frontiers, with complete new values, a global world, in the middle of post industrial revolution, neo liberal policies and no jobs. In contemporary society education institutions have a crucial role in the formation of the new citizen. Schools are now an open space, connected with the world with the goal to form a society where man is in the center and technology is in the context as an instrument to promote the well fare of humanity.

In 1996 the Education Ministry of Brazil published the Federal Law no. 9.394 known as LDB – Basis and Directress Law of Education. With this new Law it started the educational reforms with the objective of increasing the quality of 3rd Grade in the Country. Although the reforms are associated to a political project of the present team of Republic, the real motivation is due to the consequences of a

new social and technical post industrial paradigm recognized simply as: Globalization. Among all the characteristics of this new productive model, the most interesting one may be the intense use of information technology as an aggregation factor of people and markets.

In this context SENAC School of Engineering and Technology is committed with a kind of democratic education, which in essence, is the democratization of the access to knowledge socially produced, qualifying people to perform their citizenship fully.

The proposal of Telecommunication Engineering program of SENAC School of Engineering and Technology contains in its curriculum the "free period". It is called so because it is a time the students have to attend classes in the several other areas of knowledge, in one of the Units of SENAC. It is a very dynamic process of education, which mobilizes not only the students but also many faculty members of different units of the Institution promoting, this way a changing of information that are very valuable to the improvement of the students and teachers.

### ELECTRICAL ENGINEERING IN BRAZIL, A HISTORY OF DEVELOPMENT

The first practical applications of electricity were telegraphy, telephony and lighting. Since then, the use of electricity has multiplied quickly and electrical engineering has unfolded in many specialization areas. Besides the traditional areas there are those, which have originated from electrical engineering, like computing, process control, automation in general and many others of modern engineering.

The first installations of telegraphy in Brazil occurred in 1852. The first telephone line was installed in 1878. The first cities installed public lighting with incandescent lights were Campos - Rio de Janeiro State, in 1883 and Juiz de Fora – Minas Gerais State, in 1889.

Electrification in Brazil started in fact in Juiz de Fora, in 1889 with the first Hydroelectric Mill of Brazil and South America, the Mill of Marmelos. Eleven years after that, in São Paulo State was installed the Mill of Parnamba and so it started to count with a permanent public service of a hydroelectric mill. The São Paulo Light Co. as it was known has begun a new phase in this history. Between 1905 and 1908, in Rio de Janeiro, the Rio de Janeiro Tramway, Light and Power Co Ltd. Has built the Mill of Ribeirão das Lages.

<sup>1</sup> Claudio da Rocha Brito, SENAC School of Engineering and Technology, Av. Dr. Epiácio Pessoa, 248 - 33, 11.045-300, Santos, SP, Brazil, cdrbrito@lusiada.br

<sup>2</sup> Melany M. Ciampi, SENAC School of Engineering and Technology, Av. Dr. Epiácio Pessoa, 248 - 33, 11.045-300, Santos, SP, Brazil, melany@lusiada.br

<sup>3</sup> Ricardo C. Molina, SENAC School of Engineering and Technology, Av. Dr. Epiácio Pessoa, 248 - 33, 11.045-300, Santos, SP, Brazil, rcmolina@sp.senac.br

These facts and the Mill of Cubatão – São Paulo State mark the beginning of electrification in Brazil.

An analysis of electrical energy conquests that were realized in USA and Europe shows that the insertion of electrical energy in Brazil happened in the same historical moment of industrial expansion and development of developed countries. And in parallel, electrical engineering in Brazil has emerged and developed. The Mill of Parnamba had the capability of 2.000 kW, amplified later to 16.000 kW transmitted to São Paulo from a distance of 33 Km, under the tension of 24.000 V that were later raised to 40.000 V.

As Brazil has become in one of the biggest market not only of equipment for generation, transmission and distribution of electrical energy, of electrical equipment for industries, but also the lighting and the use in buildings and residences so a powerful industrial park was installed to supply the sector. Once more Brazilian electrical engineering was involved and has found new opportunities to improve.

In the last 40/50 years, Brazil designed and built, essentially with its own engineering, some of the biggest energy generation systems, ever built in the world, like hydroelectric complex of “Ilha Solteira”, “Itaipu” and “Tucurum”.

So the education institutions in the main cities of the country have started to offer electrical engineering programs. Some of them have adapted the German model of Polytechnic School of Zurich. And most of them still follow this model.

The relevance of the History of Electrical Engineering in Brazil resides in the fact that it is also the History of Engineering Education in Brazil [1].

### **THE SENAC INSTITUTION**

Blazing new trails, keeping ahead of change, signaling new trends. And more: turning all this into a consistent project of support for people and organizations in the world of work and business. At the turn of the century, SENAC has wholeheartedly taken up the challenge of the processes that have as a scenario an economy made dynamic by new technologies, by galloping globalization and the fierce competition [2].

In the mid-1990s SENAC realized that it did not have to concentrate all the diffusion of knowledge within its own physical facilities. The Educational Centers are essential for the provision of courses and tailor-made packages for firms, and for holding seminars and congresses; but there are other ways of making expert information widely available. This led to the creation of SENAC and SENAC's Publishing House.

The setting up of the SENAC publishing house was a vital step in extending educational activities to a broader public.

Investment in distance education culminated in the launch of TV SENAC. The result of a consistent successful

plan for gradual expansion, the new channel soon achieved nationwide coverage, with the distribution of its signal via satellite, cable and open channels. The first privately owned channel in Brazil to deal exclusively with education and the fostering of citizenship, SENAC TV Network, to use its present name, is a breathtaking succession of achievements. Gratifying achievements such as the technical standard of its programming and the formal solutions of its content. Twenty-four hours a day, every day, the station discusses leisure, culture, quality of life, citizenship, and the world of work, through reports, documentaries, telenews, debates and interviews.

Since the launch of its pioneering Technology Course in Hotel Management in the late 1980s, SENAC - SP has steadily and judiciously broadened its portfolio in the field of Higher Education.

Today it offers over ten titles under the aegis of the SENAC Colleges. As always it pursues innovation, gearing its efforts toward the newest, most promising fields of knowledge and toward the labor market. The differentiated programs include Hotel Management, Fashion Design, Multimedia Design, Computer Science, Environmental Management and others.

At graduation level it offers equally varied programs, with specialization in Health Care, Tourism Gastronomy, among others.

### **A NEW PEDAGOGY**

The knowledge penetrates the mind when it follows a process, or when it happens in a way, which rouses the interest or better, the hunger for more and more knowledge. This process (let us call it process) has three steps: the cognitive, the feeling and the action; in other words, it is necessary to understand first, then to feel and finally to act to accomplish the whole education process.

It implies in a positive changing and if it is adequately directed it can make a difference in a life. The doses of knowledge must be of a magnitude that is able to start a crisis of curiosity. This approach considers the students as human beings full of possibilities who need just a push to awaken for the fact that we all live in a world where men share natural resources and that science can make life better.

Taking into account that engineers help to build up the world this proposal of education very democratic one, where the students can choose their ways to get their path to science and technology to foster the development and well fare of society, despite policy and philosophy.

Having extra classes of other fields of knowledge the students have the necessary doses of information to start the crisis of curiosity enough to make a difference in their formation. New skills rise, new focus and a whole spectrum of possibilities are discovered and so the education process is accomplished.

## A DYNAMIC APPROACH IN ENGINEERING EDUCATION

The Telecommunication Engineering Program was elaborated so that it is possible any change in the curriculum that is necessary to modernize the program [3].

This Program contains in its curriculum what was named "free period". It is called so because it is a time when the students have to attend classes in the several other areas of knowledge in one of the Units of SENAC. The main characteristics of this program are:

- The students are free to choose among the many options like environment issues, nursery, photography, design, fashion, languages, art, and many others, whatever they want.
- They can choose as many areas as they want along the five years, at least one per two years.
- At the end of the each period they have to present a report about their development.
- The report is showed and discussed with a council compounded of a psychologist, a pedagogue, an engineer professor and the coordinator of the program [4].

The program is a five years program, under graduation, morning or afternoon classes. The students have the basic science courses, basic engineering courses and specific engineering courses besides the courses they choose to attend during the "free period".

The curriculum was elaborated in according to the curricula directress established by the Federal Law No. 9.394 known as LDB - Basis and Directress Law of Education, of 1996 [5].

### THE PROGRAM

As mentioned above the curriculum was elaborated so that any change can be made with the goal of modernizing the program constantly [6]. So the blocs of courses were conceived as it is showed below:

- 1st. Year: Differential and Integral Calculus I; Analytic Geometry and Vectorial Calculus; Algebra and Mathematics Logic; General and Applied Physics I; General and Technological Chemistry; Descriptive Geometry and Technical Draw; Computer Architecture; Programming and Algorithm.
- 2nd. Year: Differential and Integral Calculus II; Numerical Calculus and Linear Algebra; Statistics and Probability; General and Applied Physics II; General Mechanics; Transport Phenomenon; Material Resistance; Elements of Environmental Science; Electrical Circuits; Electromagnetism; Data Structure; Computer Organization.
- 3rd. Year: Applied Law (Legislation for Engineering); Economy and Management Elements; Electricalmechanic Conversion of Energy; Symbolic and Numerical Computer; Electronic; Operational

Systems; Construction Techniques of Programs; Antennas and microwaves; Formal Languages and Automata; Communication Systems; Digital Laboratories; Electrical Materials and Processes.

- 4th. Year: Digital Systems; Automatic Control; Digital Communications; Software Engineering; Hydraulic, Thermal and Electrical Machines; Graphic Computer; Teleprocess and Computer Network; Digital Processing and Stochastic Processes Signals; Mathematical Programming; Software Engineering Laboratories.
- 5th. Year: Integrated Circuits Conception; Telephonic Systems and Planning Systems of Communications; Tolerance Basis to Flaws; Communications Technology; Artificial Intelligence; Data Base; Generation, Distribution and Transmission of Electrical Energy; Teleprocessing Laboratory and Computer Network; Final Project; Supervised Internship.

This proposal of Telecommunication Engineering, as mentioned before, is to form Electrical Engineers with solid knowledge of Communications.

### THE TELECOMMUNICATIONS ENGINEER PROFILE

The main aspect of the Engineer of Telecommunications of SENAC School of Engineer and Technology is that s/he is professional with solid theoretical knowledge - hardware and software - having also the notions of economy, management and law. S/He is prepared to specify, to conceive, to develop, to implement, to adapt, to produce, industrialize, to install and maintain computer systems, as well as to complete the integration of physical and logical resources necessary to take care of the information, computer and automation necessities and general organizations [7].

S/He is a professional with training in new communications methodologies by means of Electronic (radio, Television, microwave, telephony, etc).

In terms of work market, our engineers have a larger knowledge in telecommunications so that s/he can be a candidate in telecommunications equipment industry, entertainment industry and also in the concessionaire of telecommunications, flying companies, tramways companies, big corporations besides enterprises of engineering telecommunication design.

S/He is a professional, who although is a specialist in communications can act in any area of electricity, because s/he is an Electronic Engineer and an Electrical Engineer.

Added to this the "free period" is a great opportunity for them to refine their knowledge of humanity necessities, the local and global context in which they are immersed. All this knowledge enriches their professional activities.

### FINAL COMMENTS

This kind of education provides for many students a great opportunity to full fill the lack of some areas of knowledge,

which because of some reasons it was not possible for them to achieve, like the knowledge of languages, for example or design and others.

The goal of this program is to form a new engineer for next century, a professional with the skills of noticing the smallest changes along the time due to the development of science and technology that has been modifying the entire world. It is essential the development of the ability of seeking for the best solution for the problems, the right use of information to foster the progress of the society, rationally. It is about the quality of actions, decisions and design.

Besides it involves quite a number of faculty members, including from other units. In fact, it demands true commitment of all board to accomplish the project.

### BIBLIOGRAPHY

- [1] Vieira, A. H. G.; Brito, C. da R. "História da engenharia elétrica no Brasil". In: Vargas, M. Contribuições para a história da engenharia no Brasil. São Paulo, EPUSP, 1994. p. 259-272.
- [2] Fonseca, M. "Professional education and the fostering of citizenship", São Paulo: SENAC. 2000.
- [3] Brito, C. da R.; Ciampi, M. M.; Molina, R. C. "Scientific and Technological Initiation Projects in the Consolidation of Engineering Education". In: Internationalen Symposiums "Ingenieurpädagogik 2000", 29., Biel-Bienne, 2000. Unique and Excellent: Ingenieurausbildung im 21. Jahrhundert. Biel-Bienne: IGIP, 2000. p. 716-721.
- [4] Brito, C. da R.; Ciampi, M. M.; Molina, R. C. "Teaching with Research". In: Interamerican Conference on Engineering and Technology Education, 6., Cincinnati, 2000. Proceedings INTERTECH-2000. Cincinnati: INTERTECH, 2000. (in CD-ROM).
- [5] Brito, C. da R.; Ciampi, M. M.; Molina, R. C. "Research as integrated part of an Engineering Curriculum". In: American Society of Engineering Education Annual Conference, 107., St. Louis, 2000. 2000 ASEE Annual Conference Proceedings. St. Louis: ASEE, 2000. (in CD-ROM).
- [6] Brito, C. da R.; Ciampi, M. M.; Molina, R. C. "The Dynamic Engineering Education of SENAC – School of Engineering and Technology". In: International Conference on Engineering Education, 6., Taipei, 2000. Proceedings ICEE-2000. Taipei: ICEE, 2000. (in CD-ROM).
- [7] Brito, C. da R.; Ciampi, M. M.; Molina, R. C. "Human Resources Development in Brazil". In: Pacific Conference on Manufacturing, 6., Detroit, 2000. Proceedings PCM-2000. Detroit: PCM, 2000. v. 2, p. 527-532.