

## **A New Approach to Engineering and Technology Education and the New Pedagogy**

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### **Abstract**

A new Pedagogy has emerged as a consequence of a new educational paradigm. This new pedagogy preaches the commitment of family, society and educational institutions. SENAC School of Engineering and Technology has implemented a Telecommunication Engineering Program that contains in its curriculum what is called “Free Period”, which is in according to the new paradigm of education. The students have a free time during the week when they can attend classes in one of other SENAC units. They can attend as many courses as they want at least one per two years. They are free to choose among the many options like environment, fashion design, nursing, photography, media design and others. At the end of each period they present a report about their development, which is evaluated by a council compound of a psychologist, a pedagogue a professor of engineering and the coordinator of the program. The goal is to form engineers with a vision to the future, a professional that is able to see the opportunity without losing the perception of human dimension and how much it implies in a search for answers of the several challenges of engineering. At the end of the program the students have solid knowledge of basic science courses, basic engineering courses and specific engineering courses, besides the experience acquired with the development of projects in partnership with enterprises.

### **I. Introduction**

People live today 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. 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.

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. 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 welfare of humanity.

In this context SENAC School for Engineering and Technology is committed with a kind of education, which is in essence 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. The goal of this new kind of engineering education is to increase their perception of human dimension and how much it implies in the search for answers to the several problems of engineering to the service of human kind aiming at a better future.

## **II. A little of History: Electrical Engineering in Brazil**

History is an important data to understand the present. It is not different when it is about Engineering in a Country like Brazil, a Country of American Continent, 500 years old, with peculiar characteristics of colonization and 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. 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 <sup>1</sup>.

### **III. What SENAC is and its Relations with Contemporary Brazilian Society**

As important as to understand Brazil a Country of 500 years of existence, is to understand what SENAC is. It is a special kind of institution, which has emerged in the 40's. SENAC means “National Service for Learning”. It is one of the largest education institutions of Brazil. It has units all over the Country and it has 52 units only in São Paulo state that is one of the 25 Brazilian states.

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 <sup>2</sup>. 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. It is a history of hard work, investment and success in education in Brazil.

#### **IV. Education Paradigm in discussion**

Science and technology have contributed to the progress of society creating machines, each time more and more sophisticated to help men with hard work.. Science and Technology have also increased the communication and transportation, decreasing distances and connecting the entire planet and so shaping a different style of life to people. These happenings have a straight incidence in education in every level. The main consequence is the demand of a new kind of professional and so a new education paradigm has emerged. From now on the education approaches contempt the “Construction of Knowledge”, which is based in Papert’s education approach. It is the “learning by making”, which is in according to the new work paradigm demand. It is the formation of a professional who will be capable to insert and to maintain her/himself in the global, mutant and challenge work market of the new century. The teacher is more an advisor, a master who helps the students to find their own path to achieve knowledge and to accomplish their projects. The teacher is the master behind the student lighting the way.

#### **V. The Proposal of the Project**

The present proposal of an Engineering Program of SENAC School of Engineering and Technology has emerged inserted in a context of international integration, of deep and radical changes in producing systems and society. To defeat the demand of a changing work market, more than ever it is necessary to have a constant modernization of a curriculum. Attempt to that, the Telecommunication Engineering Program was elaborated so that it is possible any change in the curriculum that is necessary to modernize the program <sup>3</sup>.

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 <sup>4</sup>.

It 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 curricula 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 <sup>5</sup>.

## VI. The Telecommunication Engineering Program

To attend the necessity of changes in the curriculum with the goal of modernizing the program, the blocs of courses were developed as it follows:

- 1<sup>st</sup>. 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.
- 2<sup>nd</sup>. 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.
- 3<sup>rd</sup>. Year: Applied Law (Legislation for Engineering); Economy and Management Elements; Electrical mechanic 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.
- 4<sup>th</sup>. 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.
- 5<sup>th</sup>. 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 <sup>6</sup>.

## VII. The Telecommunications Engineer Profile

In according to the new work market of a global society the Engineer of Telecommunications of SENAC School of Engineer and Technology is a 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 <sup>7</sup>. S/He is also 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. They are professionals, who although are specialists in communications can act in any area of electricity, because they are Electronic Engineers and an Electrical Engineers. 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, becoming them competitive in terms of quality of work.

### **VIII. Final Comments**

The “free period” project offers the students an opportunity to fulfill the lack of knowledge that they have.

The developed educational project is based on innovative active learning paradigm of education and student centered approach to teaching. It is a project that requires an involvement of many faculty members, not only of Engineering School but also of other units for the achievement of the goals.

The coordinating team truly believes that this project will serve a good model for engineering education program that can be adopted by other Brazilian educational institutions.

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