

BRAZIL'S FIRST UNDERGRADUATE COURSE IN ACOUSTICAL ENGINEERING

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1. INTRODUCTION

It is certainly a common agreement among the participants of the CAA meeting that acoustics as a branch of science occupies an important position. In contrast to its importance it is indeed a science that is, worldwide, often only marginally incorporated into teaching curricula of universities. And while, for example, at some German universities acoustics is very well represented in their curricula, the situation in Brazil was quite different, mainly due to the lack of a comprehensive curriculum that accounts for basic education in acoustics. Contrary to this scenario, there is an enormous demand for acoustic engineers in Brazil. To account for this demand, in the end of 2008 a dedicated undergraduate course "Acoustical Engineering/ Engenharia Acústica" started at Federal University of Santa Maria, which is oriented to the German and Chilean model. As part of the article, the structure of the program will be presented and discussed.

2. BIRTH OF A NEW UNDERGRADUATE COURSE

Brazilian industry, and to a minor extent governmental agencies as well, are looking hard for engineers who have acoustics backgrounds to work in product development, environmental noise, and building acoustics. Up to now the candidates for such positions have come from the very few Master's and PhD programs dedicated to acoustics and vibration or were trained in-house. Neither solution was sufficient, because acoustics is a many faceted field of science and its knowledge can hardly be taught with a Master's or even PhD program only. Also, the Master's and PhD programs currently available in Brazil do not qualify a sufficient number of acousticians. Finally, for many smaller industries Master's and PhD degree holders are usually too "expensive" to be employed.

An undergraduate course in acoustical engineering was thus highly desirable. In 2008 the conditions to implement such a course, as well as others, were so far favorable as a Governmental higher education policy framework that aimed to increase the number of students in federal universities was in place.

A small acoustics working group that existed in the Civil Engineering Department of the Federal University of Santa Maria, southernmost Brazilian state of Rio Grande do Sul, was then transformed into the germ cell of a new undergraduate course in Acoustical Engineering. Beyond

this, the favourable higher education policy Brazilian industry and the Brazilian Society of acoustics are also interested in such an undergraduate course.

3. CURRICULUM

The curricula was developed using experiences from Chile and Germany where similar undergraduate courses exist. Naturally, a number of rules that apply for an undergraduate course in Brazil were to be followed, e.g. a minimum 3600 hours of classes. The course in Acoustical Engineering has a total of 3750 hours, divided into 3375 h for compulsory topics (Table 1), 315 h for optional topics and 60 h for additional activities. Out of the 3375 hours of compulsory topics, 1260 h are dedicated to fundamentals, 720 h to general engineering topics, and 1395 h to acoustics topics, including an internship of 210 h in the last semester. Optional topics are either (1) technical and non-technical topics offered by the university or (2) special topics in acoustics offered by the undergraduate course or other universities, especially in foreign countries. Additional activities are activities such as participation in conferences on acoustics, research projects in acoustics, and the like. In order to provide some attractions from the very beginning of the course, dedicated lectures on topics related to acoustics are introduced in the first semester ("Music for Acoustical Engineers" starting in the first semester and "Noise, Vibration, and Humans" in the second semester). Especially the latter discipline is also intended to provide interdisciplinary points of view to the students.

4. ACADEMIC STAFF

For the topics that are related to acoustics, audio, and vibration, though currently still in the civil engineering department, the future department of acoustical engineering will have a total number of nine lecturers in the near future. Today 5 positions are filled with lecturers from Brazil, Chile, and Germany, most of them with international experience or even foreigners, and over the following two years the remaining four positions are to be completed with specialists in Structure borne sound, Audio, Digital Signal Processing, and Room- and Building acoustics.

5. FACILITIES AND EQUIPMENT

Currently the facilities that are associated to the course are acoustical laboratory facilities of the Department of Civil Engineering, composed primarily of a reverberant chamber (207 m³) for measuring absorption and sound power, as well as another pair of reverberant chambers (60 and 67 m³) to measure sound transmission, principally walls and other

types of room partitions. Another pair of rooms is used to measure tapping sound transmission. Recently the course acquired a large amount of new equipment, from basic tools such as microphones and accelerometers to several types of impact hammers, manikins, sound intensity probes, SPL-meters, and many others. Some software was acquired as well such as ArtemiS, Bastian, Dirac, Odeon, Pulse, SoundPlan, and VAOne. At the moment, a project is being elaborated to expand the facilities, adding a fully anechoic chamber, a recording studio, a sound booth, a new chamber for tapping sound measurements, and a library, etc. Further audio equipment and software must be still purchased.

6. RESEARCH ACTIVITIES

While the laboratory in the past worked mainly on small scale projects in building acoustics, the new staff and equipment will offer the possibility to start more dedicated research in a wider variety of fields. Research into building acoustics will be maintained and strengthened, as the reverberant rooms at the laboratory are the only ones in Brazil that allow for transmission loss measurement of whole room partitions. Other projects such as research in room acoustics, aircraft noise problems, psychoacoustics, and sound evaluation and aero-acoustics are being started.

7. NATIONAL AND INTERNATIONAL COOPERATION

National and international cooperation will be an important aspect in the development of the course and the research projects to be developed. First, cooperation started with the Federal University of Santa Catarina (Brazil) and RWTH Aachen University (Germany). Others are expected to follow soon, such as projects with McGill (Monteral), Universidad Austral (Valdivia, Chile), and the Technical University of Berlin (Germany).

8. CONCLUSIONS AND OUTLOOK

To help with education in acoustics, to provide skilled acoustical engineers to the job market, and to develop dedicated research in acoustics, Brazil's first undergraduate course in Acoustical Engineering has opened at the Federal University of Santa Maria with an attractive curriculum. It is expected that interesting research will be developed, together with other universities and private or public entities.

Table 1. Curricula (all compulsory +some optional topics)

sem	topic	hours
1	Math A	90
	Linear algebra A	90
	Introduction to geometry	45
	Introd. into Acoustical Engineering	45
	Chemistry	30
	Music for Acoustical Engineers I	30
2	Physics I	75
	Math B	90
	Linear Algebra B	90
	Sound, Vibration and Human Being	45
	Technical drawing	45
	Music for Acoustical Engineers II	30
3	Physics II	75
	Differential calculus A	60
	Numerical methods	60
	Material science	60
	Resistance of material	60
	Music for Acoustical Engineers III	30
4	Physics	90
	Differential calculus B	60
	Complex variables	60
	Fundamentals of Civil Engineering	60
	Programming	90
	Music for Acoustical Engineers IV	30
5	Thermodynamics	60
	Technical English and Portuguese	45opt
	Statistics A	60
	Fundamentals of Acoustics	75
	Electrical circuits I	60
	Fundamentals of Electronics	60
6	Fluidynamics	60
	Economics	60
	Room acoustics	60
	Noise Control	60
	Fundamentals of Vibration	75
	Electric Circuits II	60
7	App. Electronics and Instrumentation in Acoustics	60
	Urban Noise Control	60
	Cientific working	30opt
	Vibration Control	60
	Building Acoustics	75
	Electroacoustics I	60
8	Psychoacoustics	75
	Digital signal processing	60
	Measurement techniques	60
	Bachelor project I	30
	Security on the workplace	45opt
	Numerical Methods in Acoustics and Vibration	60
9	Electroacoustics II	60
	Sound Reinforcement System Theory	60
	Sound Reinforcement System Practice	60
	Digital Signal Processing II	60
	Subjective sound evaluation	60
	Auralization	60opt
9	Start-up for enginners	60
	Exp.methods in Acoustics and Vibration	60
	Loudspeakers	60
	Recording techniques	75
	Bachelor project II	30
	Project	60opt