Department of Mathematics
and
Learning Resource Center of the First Year of Studies

Special Seminar on Undergraduate Mathematics Education

Date: Thursday, June 13, 2013
Time: 2:00-3:00 PM
Room: Hurley 258

Speakers: Professors Ricardo Pulido & Ruth Rodriguez, Tecnologico of Monterrey, Mexico

Titles & Abstracts:

1) Changing the vision of teaching calculus through the research on Mathematics Education. A concrete experience. Ricardo Pulido, Tecnológico of Monterrey (México)
In this talk we are going to mention some problems on learning and teaching calculus when we focus on engineering students. We will analyze some aspects of the content of calculus textbooks that underlay in those problems. We will talk about how we have constructed an alternative vision of calculus, some particularities of this and, finally, how it is working now.

2) Innovation in the Teaching and Learning of Differential Equations Through Modeling and Technology

Ruth Rodríguez, ruthrdz@itesm.mx, Tecnológico of Monterrey

The purpose of this paper is to share the experience of an educational practice in a private university in the Northeast of México (Tecnológico de Monterrey, Monterrey Campus) about a different way to teach Calculus and Differential Equations courses for future engineers based on a proposal developed by the Math faculty over 14 years. This proposal set off from the idea of re-designing the scholar mathematical discourse present in the Integral and Differential Calculus courses for engineers. It emphasizes that Mathematics is, above all, a human activity that answers several problems of different nature (physical, chemical, biological, etc.), and throughout this problem solving activity it is likely that the emergence of mathematical concepts, notions and procedures occurs.
Students first learn the instrumental aspect of mathematical notions. After proper manipulation, they can theorize about the properties of the objects. This proposal considers that the emergence of mathematical knowledge is significant from the historical and epistemological points of view, and that the teaching of mathematics to future engineers should take into account these stages.

The outcomes of this proposal have been published in the form of four student textbooks –Pre-Calculus, Differential Calculus, Integral Calculus and Multivariable Calculus. The work is still in progress; however, there has been great advance in the curriculum design for Differential Equations. Since 2008, **innovative material** (hands-on activities, laboratory practices, modeling and simulation practices, worksheets/spreadsheets) has been developed for the DE course. Its main axis is concerned with the modeling

of biological, physical or chemical phenomena.

Recent research has shown the need to change the way to teach DE, from the "traditional" way, which emphasizes analytical methods, to an integrative mode, which uses graphical and numerical methods. This integrative mode should enable students to identify and recognize a DE in its different representations; and thus, improve the learning of DEs as mathematical objects. The student should not only learn how to use techniques to solve DEs but also learn the application of the DE as a tool to model several problems. This is also strengthened through the use of specific technology and software such as CAS (Maple and Mathematica); simulations, and laboratory practices with sensors in the classroom to better model and understand the phenomenon to study: temperature, an RC circuit, or a spring-mass system. The student should be capable of **integrating technical knowledge** (DEs) with practical skills through modeling. Different learning active environments play an important role in promoting the implementation of the course with **hands-on, modeling, and simulation activities; and the development of communication, problem solving and modeling skills**. Since 2010, we have implemented the DE course in the ACE classroom following the North Carolina University SCALE-UP model. Evidence has shown that future engineers achieve better understanding of the math concepts after *living* this educational practice and further develop other skills (social, communicative, modeling and technological) along with the mathematical.