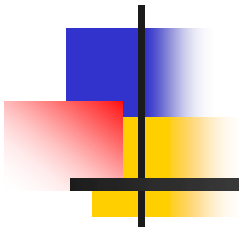# CAS Education Workshop
Teaching Circuit Courses to Engineering Students

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Seattle, May 22, 2008

Two decades of an ongoing debate

[1] R. Rohrer, "Taking circuits seriously," IEEE *Circuits and Devices Magazine*, vol. 6, no. 4, pp. 27-31, July 1990.

[2] Y. Tsividis, "Some thoughts on introducing today's students to electrical engineering," *IEEE CAS Newsletter*, vol. 9, no. 1, p. 1, 6-7, March 1998.

[3] Y. Tsividis, "Teaching circuits and electronics to first-year students," *Proc. IEEE Int. Symp. Circuits and Systems*, Monterey, CA, May/June 1998, pp. 424-427.

[4] Y. Tsividis, "Turning students on to circuits," *IEEE Solid-State Circuits Newsletter*, pp. 6–9, January 2008.

General approach

Basic and advanced circuit theory courses:

■ Simon Fraser University:

 ENSC 151: Microprocessor lab

http://www.ensc.sfu.ca/~ljilja/ENSC151/

* ENSC 220 Basic Circuits I:

 http://www.ensc.sfu.ca/~ljilja/ENSC220/

* ENSC 320 Basic Circuits II:

 http://www.ensc.sfu.ca/~ljilja/ENSC320/

** ENSC 895/ENSC 460: Special topics: Theory, Analysis, and Simulation of Nonlinear Circuits:

 http://www.ensc.sfu.ca/~ljilja/ENSC895/

 * offered twice a year (trimester system)

 ** offered in Spring 2004 and Fall 2007

General approach

Digital Signal Processing (DPS) first,
experiences from Georgia Tech and UC Berkeley experiments:

- UC Berkeley:

  * Spring 2006

  EE 20 Structure and Interpretation of Systems and Signals

  http://webcast.berkeley.edu/course_details.php?seriesid=1906978285

  * Taught at UC Berkeley in Spring 1997

Targeted audience

Design tailored circuit courses for a garden variety
of engineering student majors:

- electronic engineers
- computer engineers
- bioengineers
- mechatronics majors

Not all will be circuit designers and may need circuit curses
carefully tailored to fit program specific curricula.

Choosing the right text

Is the cookbook approach offered by a myriad of textbooks available in our bookstores (at a hefty price) serving future electrical engineers well?

- Student feedback:
  - no required text
  - recommended texts only

Library reserves

- Raymond A. DeCarlo and Pen-Min Lin, *Linear Circuit Analysis: Time Domain, Phasors, and Laplace Transforms Approaches, 2/e*, Oxford University Press, Cambridge, MA, 2001.

- James W. Nilsson and Susan A. Riedel, *Electric Circuits Revisited and PSpice Supplement Package, 7/e*, Prentice Hall, Upper Saddle River, NJ, 2005.

- Norman Balabanian, *Electric Circuits*, McGraw Hill, New York, NY, 1994.

- Michael Reed and Ron Rohrer, *Applied Introductory Circuit Analysis*, Prentice Hall, Upper Saddle River, NJ, 1999.

- Roland E. Thomas and Albert J. Rosa, *The Analysis and Design of Linear Circuits, 3e*, John Wiley, 2000.

Software tools

- Lectures, tutorials, laboratories
- Using MATLAB and SPICE as supplemental tools for better understating of the theory taught:
    - short intro to circuit simulation tools
    - lab: MATLAB, SPICE, oscilloscope

Presentation styles and course delivery

From blackboard to overhead projectors to PowerPoint sides and back to the whiteboard.

Communication tools:

- web pages
- notes
- handouts
- audio recordings of lectures
- examples from industry
- puzzles
- email

Presentation styles and delivery

- Good textbook supplements (master slides, tutorial problems, solution manuals) are, in general, unavailable.
- Need for: tutorials, video-taped lectures, educational games
- Design kits (e.g., National Instruments)
- John Cohn's lectures
- IEEE.tv
- YouTube, MySpace

Laboratories

- Exercises designed to illustrate application of the theory taught, reflect modern technological advances, and are fun
- Open labs model (24/7)
- ENSC 220: five laboratories
  Final lab: build a sample radio and test the signal reception
- ENSC 320: designing and building an active low-pass filter to meet given specifications:
  - 4td order Butterworth
  - 3rd order Chebyshev
- ENSC 895/ENSC 460: final project

Recruiting future engineers

Reaching-out to high-school students by organizing visits to engineering labs, engineering days, summer camps, and summer work programs:

- High school work programs, Vancouver, BC:
  - Johnston Heights Secondary School
  - Matheson Secondary School
- Summer co-op programs for SFU undergraduate students (sponsored by NSERC)
- Summer training program:
  L'Institut des Sciences de l'Ingénieur de Toulon et du Var (ISITV)

Course instructors

- Teaching circuits as service courses by unmotivated instructors will hardly generate students' enthusiasm.

- Circuits courses are taught by sessionals and instructors as a service to the department and are often viewed as a "chore" or even a "punishment".

- If taught by more senior faculty, their research interests are in areas not related to circuit theory and/or circuit design.

In closing and looking forward

If we wish to generate interest in circuits among the incoming engineering students, we need to do a better job of promoting the profession by:

- providing betters teaching tools and delivery methods
- combining circuit theory courses with laboratory exercise
- illustrating the application of circuits in fields relevant to environment, biotechnology, medicine
- recognizing and rewarding teaching circuits courses
- doing a better job in sharing our enthusiasm for the engineering profession.

In closing and looking forward

The role of the IEEE CAS Society:

We are responsible for the current situation and we can make a difference.