

Utilization of SMET Learning Modules in an Electronics Curriculum

Academy of Electronic Media

<http://www.academy.rpi.edu>

Rensselaer

Module Utilization – Circuits studio

The interactive learning modules are used in-class as part of the Circuits Studio involving:

- *40 students/section*
 - *3 – two hour periods/week (MTR, MWR)*
 - *2 – Teaching Assistants (undergrad/grad)*
 - *“Shifting gears” 3-4 times/class period*
 - *Mini-lectures (~15min) introducing topics --- typically including a demonstration using the learning module(s)*
 - *An effort to have students “discover” and “explore” concepts*
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Module Utilization - studio facilities



LITEC Studio (inside)



LITEC Studio (outside)



Circuits/Electronics Studio

Module Utilization – sample syllabus

The interactive learning modules are used in-class as:

1. *Topic introductions*
2. *Concept visualization*
3. *Structured activities*
4. *Design problem support*
5. *Exploration & experimentation*



Day	Topics and Activities (minutes in class)
Day 6	Review of node equations (5) Mesh equations (10) Circuit Solver ILM (25) A 4-3: Writing mesh equations (20) Mesh w/ cont sources (15) A 4-5: Node w/controlled sources (10) Node/mesh applications (10)
Day 7	Statistical analysis for R (10) E-2: Statistical analysis (30) A 2-4: Superposition (15) Thévenin/Norton networks (15) A 2-5: Thévenin parameters (20) Source conversions (10) (ILM – interactive learning module)
Day 9	Ideal Op-Amps (15) Op Amp ILM (20) E-3: Op-amp circuit (40) PSpice w/cont. sources (10) C-1: PSpice amp circuit (25)


Key:
 A – activity/problem
 E – experiment
 C – computer project

Module Utilization – sample syllabus

Sample topic: *Intro to Mesh Analysis*

1. Topic introduction: *Review of Kirchhoff's Voltage Laws (PowerPoint slides – 10min)*
2. Concept visualization : *Various mesh currents are labeled and component values are selected in a 2-mesh ladder circuit (Module – 10min)*
3. Structured activities: *Various mesh currents are labeled and component values are selected in a 2-mesh ladder circuit. The students then work with the instructor (using the module) to set-up the two equations and solve for the output voltage. (Module – 5min)*
4. Design problem support: *The students use the module on their own computer to help solve the assigned problems – the students' work is "Scribed" for further analysis by the instructors (Module – 5min)*
5. Exploration & experimentation: *The module is then used to verify the students' results, when asked to design/modify the circuit for a particular V_{out} . (Module – 5min)*

Day	Topics and Activities (minutes in class)
Day 6	Review of node equations (5) Mesh equations (10) Circuit Solver ILM (25)



Learning Modules

Modules for an Electronics Curriculum

<http://www.academy.rpi.edu/projects/ccli>

Circuits	Signals & Systems	Communications
<ul style="list-style-type: none"> • Generic Voltage Divider • Caps & Inductors • Filters Introduction • Band Pass Filters • Filters CAD • Op-Amps CAD • Phasors in Circuit Analysis • Circuit Solver 	<ul style="list-style-type: none"> • 2nd Order Systems • Wave Chooser • Fourier Transform • Convolution • Time/Frequency/Laplace Domains • Fourier Signal Generator • Learning Styles Survey • A/D Conversion 	<ul style="list-style-type: none"> • Amplitude Modulation • Sampling • Analog Modulation • Digital Modulation • Pulse Modulation • Frequency Division Multiplexing • Time Division Multiplexing • FDMA

CCLI Technologies

- **WebTeam:** *students at two schools are able to jointly work on developing a bandpass filter using the Filters CAD module engine*
 - **Scribe/Bard:** *provided a means to record and playback the students' interactions with the [Circuit Solver Module](#) – which indicated that student learning was affected by first introducing Nodal Analysis (vs. introducing Node/Mesh analysis at the same time).*
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Evaluation Summary

- Formal questionnaire correlated with videotape analysis
 - Student performance improved by 9%
 - Website utilization:
 - > 1M hits/yr. (2003: 40% fall, 60% spring)
 - Greatest utilization between 10pm & 2am
 - Scribed version of “Circuit Solver” showed “block” for learning mesh analysis (based upon summing voltages - KVL) after nodal analysis (based upon summing voltages - KCL)
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Further Interest

- On the web:

<http://www.academy.rpi.edu/projects/cli>

- Sample Publications:

<http://www.academy.rpi.edu/projects/cli/pubs/FIE2001.pdf>

<http://www.academy.rpi.edu/projects/cli/pubs/FIE2003.pdf>

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