

Electronics

EE3C11

(Introduction)



Rene van Swaaij



Chris Verhoeven



Anton Montagne



Marion de Vlieger

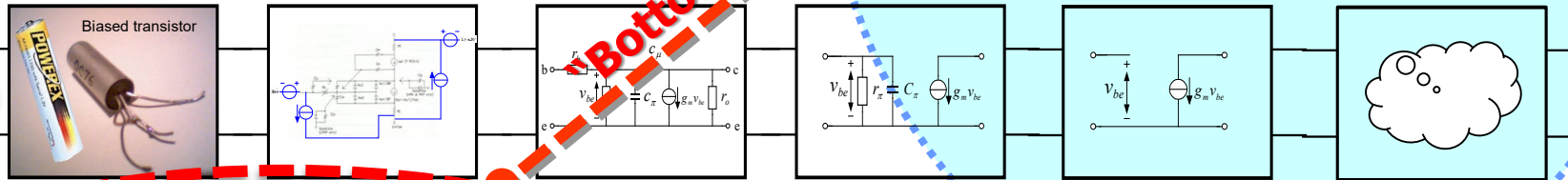
Building the “bridge”

Semiconductors

Specifications come from the top

Hardware comes from the bottom

Show-stoppers come from the bottom



Bottom-up design

Design
Methodology

Top-down design

Customer

Circuits

Content

This course is about
Technology aware
Design Methodology

Books

Electronics

Structured Electronic Design Edition 1.2

A. Montagne

This book is available at:

ETV DESK!

Semiconductors

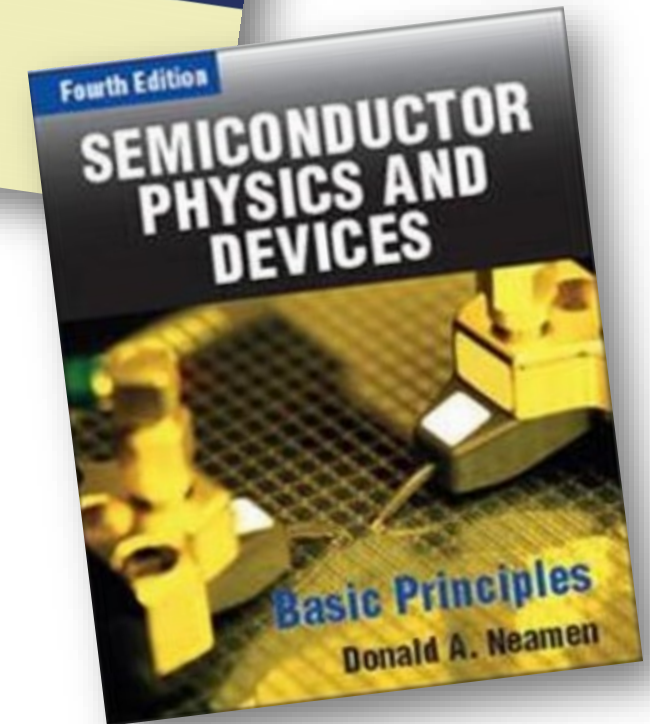
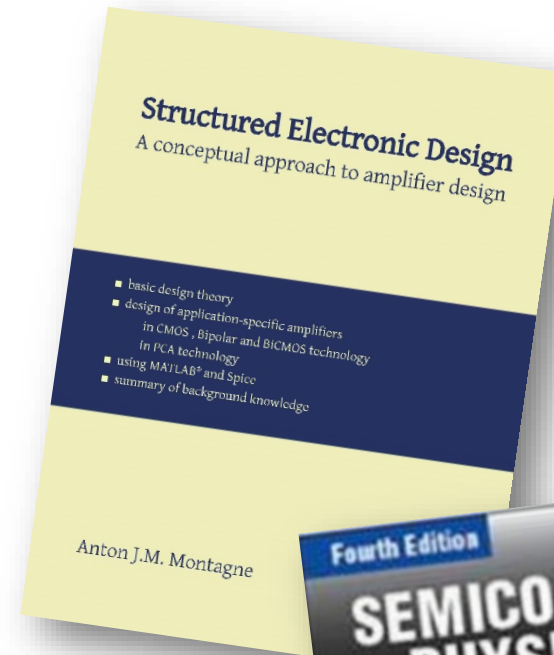
Semiconductor Physics and Devices; Basic Principles

Donald A. Neamen

McGraw-Hill International Edition, (4th edition)

This book is available at the ETV desk.

(Limited number. <20, more are ordered)



Bloom for engineers

4,5,6: Analyze, **Evaluate**, **Synthesize**

3: Apply

2: Understand

1: Remember

Synthesize

TU-Delft Engineer

Design methodology

F

6

7

8

9

10

Traditional Bloom Cycle for **Electronic Engineers**

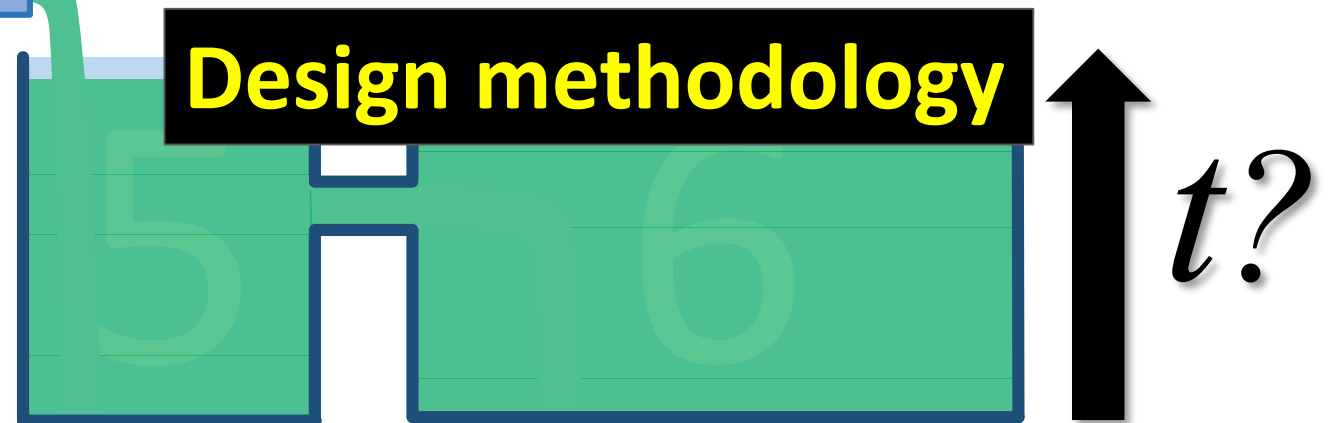
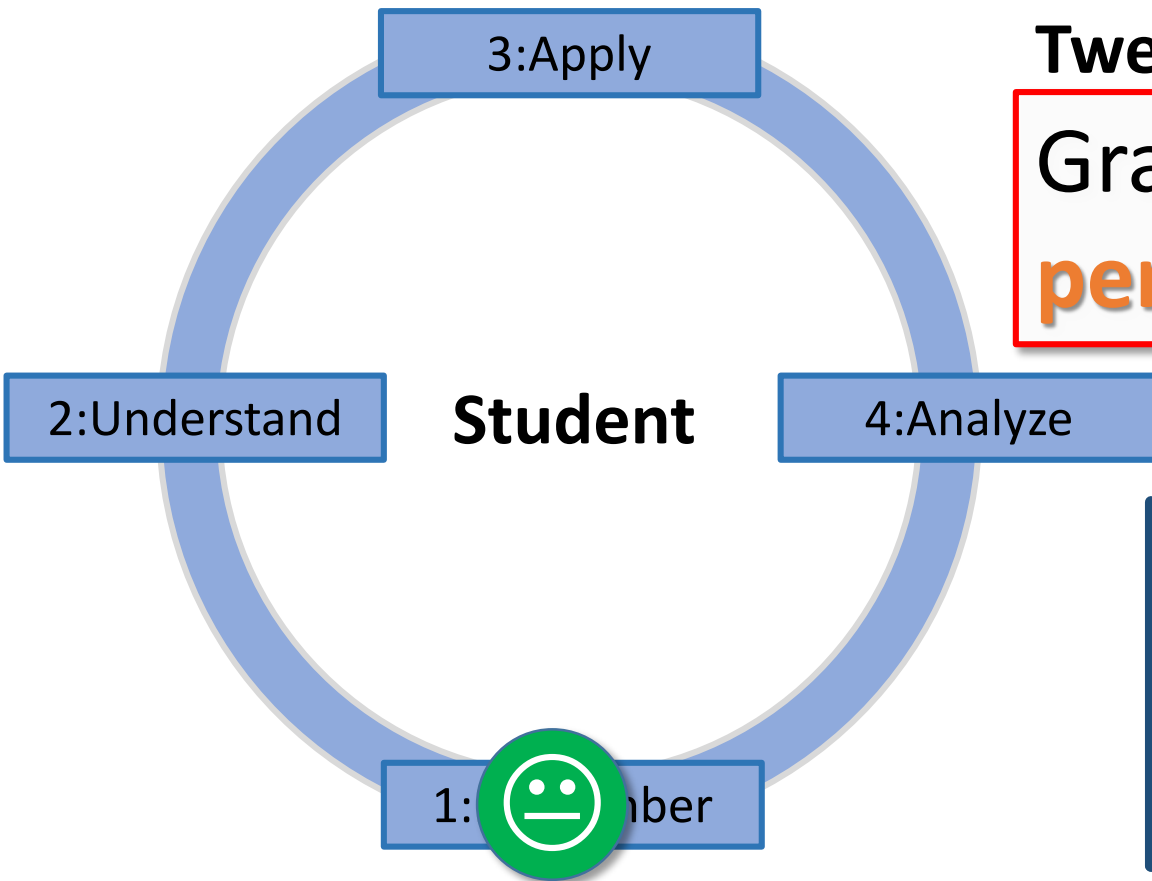
Active education until level 4

Repeat existing designs

Analyze results

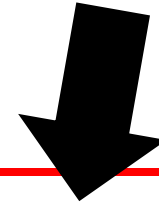
Tweak designs to meet specs

Gradually develop a
personal design methodology

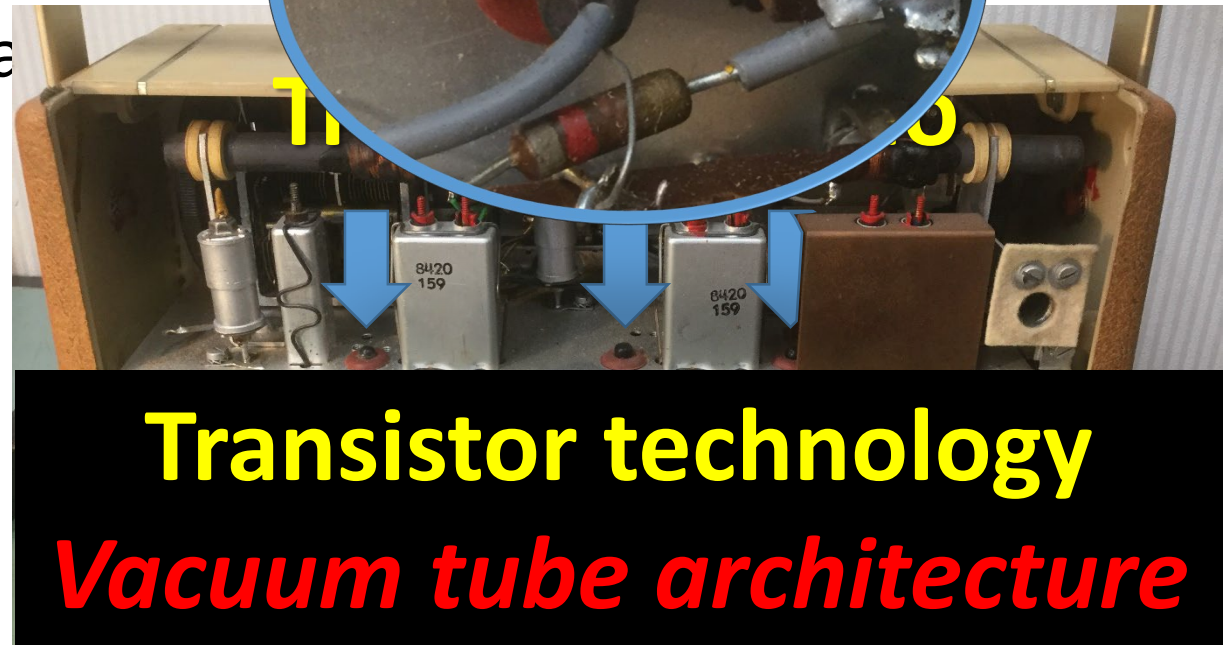
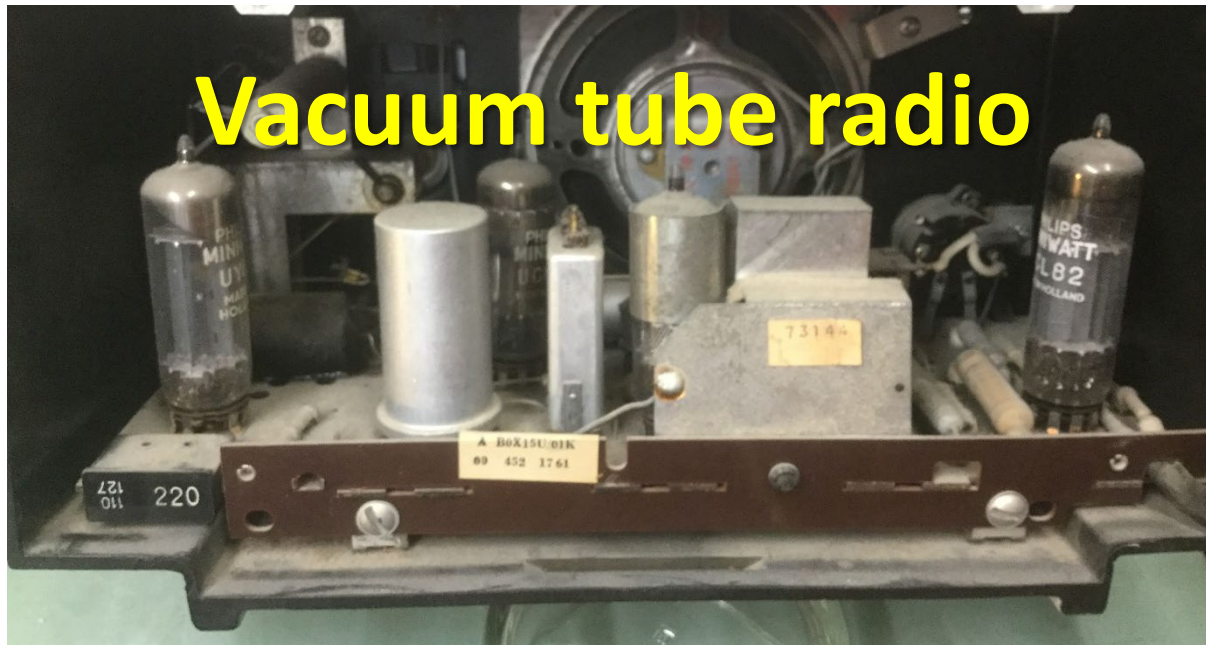




***Repeat
Analyze
Tweak***



“Experience”

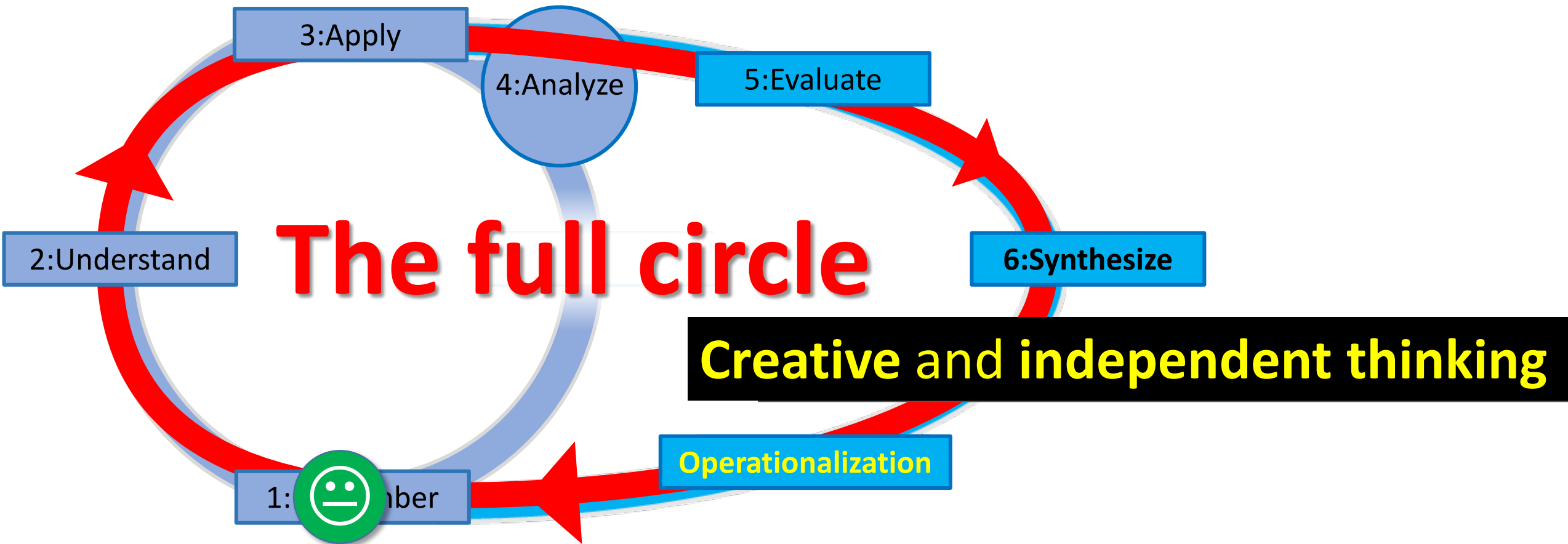


Vacuum tube radio

Transistor technology
Vacuum tube architecture

Bloom Cycle for Innovators

Active education including level 5 and 6 **and operationalization**



Not in this course

Inverting Operational Amplifier - x

https://www.electronics-tutorials.ws/opamp/opamp_2.html

Home / Operational Amplifiers / Inverting Operational Amplifier



Inverting Operational Amplifier

The Inverting Operational Amplifier is one of the simplest and most common op-amp topologies.

We saw in the last tutorial that the Open Loop Gain, (A_{vo}) of an operational amplifier can be very high, as much as 100,000 (120dB) or more.

However, this very high gain is of no real use to us as it makes the amplifier unstable and hard to control. As the smallest of input signals, just a few micro-volts, would be enough to cause the output voltage to saturate and swing towards one or the other of the voltage supply rails, we lose complete control of the output.

As the open loop DC gain of an operational amplifier is so high we can therefore afford to lose some of this high gain by adding a feedback resistor across the amplifier from the output terminal back to the inverting input terminal to both reduce and control the overall gain of the amplifier. This is known commonly as a voltage divider system.

Negative Feedback, and thus produces a very stable Operational Amplifier based system. The purpose of "feeding back" a fraction of the output back to the inverting input is to reduce the gain of the amplifier.

Inferior topology
More issues than necessary

HOW? : Create a design yourself



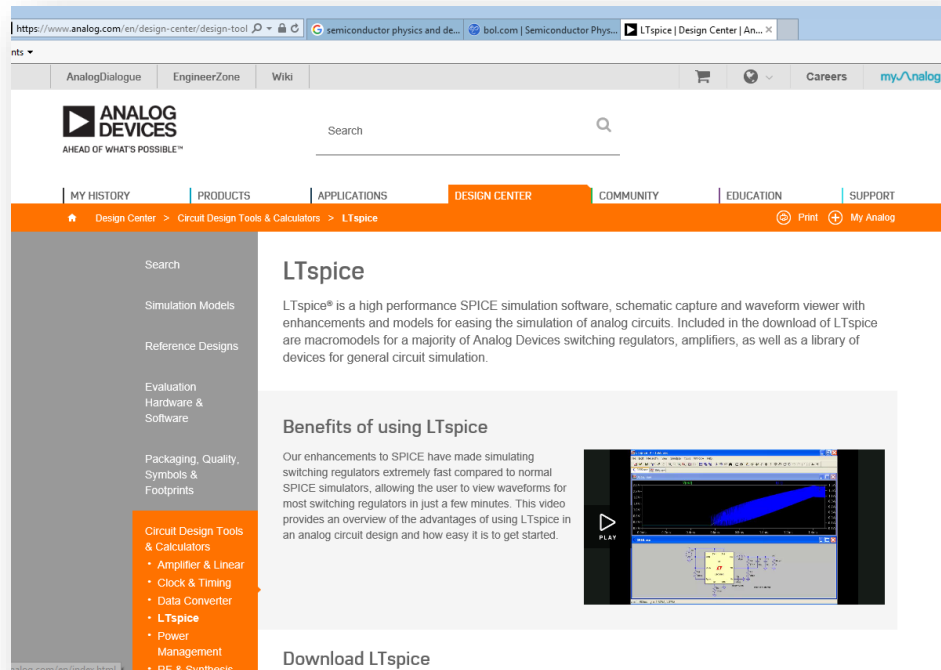
Sir Douglas Bader

“Rules are for the guidance of the wise men -
and for the obedience of fools”

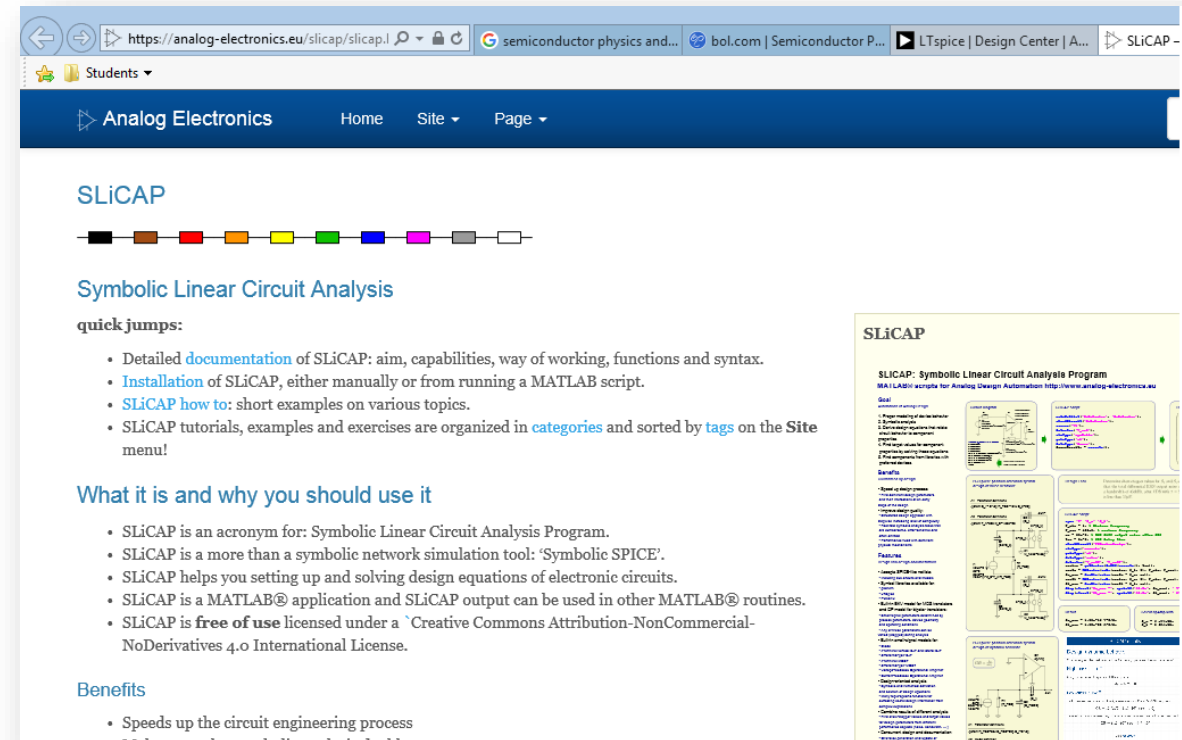
Creative and independent thinking

Operationalization

Software



LTspice®: Simulation, Schematic capture and Waveform viewer



SLiCAP : To set up and solve Design Equations of electronic circuits.

To create design documentation

(SLiCAP is a MATLAB® application: you need a laptop with MATLAB®)

HOW? : Create a design yourself

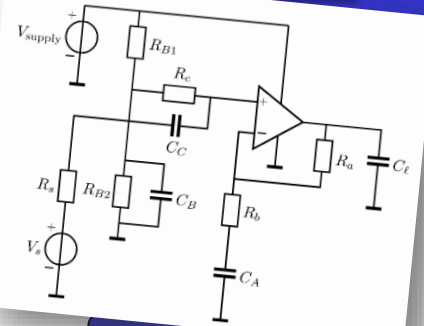
LTspice and SLiCAP

This course and related courses

Semiconductors

Top-down design

EE3C11

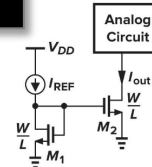


EE4109

EE4C10

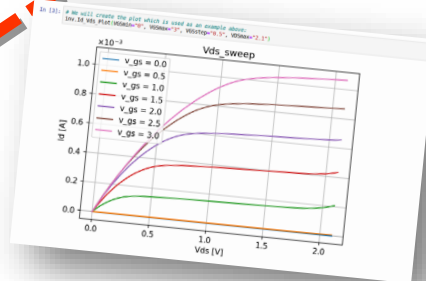
ET8011MSC
(masterclass)

EE3C11



$$I_{REF} = \frac{1}{2} \mu_n C_{ox} \left(\frac{W}{L} \right)_1 (V_{GS} - V_{TH})^2$$
$$I_{out} = \frac{1}{2} \mu_n C_{ox} \left(\frac{W}{L} \right)_2 (V_{GS} - V_{TH})^2 \Rightarrow I_{out} = \left(\frac{W/L}{W/L} \right)_2 I_{REF}$$

Bottom-up design



Circuits

Schedule

Name	Date	Time	Location
Electronics 1	Monday, February 10, 2020	10:45 - 12:45	D@ta
Electronics 2	Tuesday, February 11, 2020	15:45 - 17:45	Ampere
<i>Instructions</i>	<i>Thursday, February 13, 2020</i>	<i>10:45 - 12:45</i>	<i>Pulse-Hall 3</i>
Semiconductors 1	Monday, February 17, 2020	10:45 - 12:45	D@ta
Electronics 3	Tuesday, February 18, 2020	15:45 - 17:45	Ampere
<i>Instructions</i>	<i>Thursday, February 20, 2020</i>	<i>10:45 - 12:45</i>	<i>Pulse-Hall 3</i>
Electronics 4	Monday, February 24, 2020	10:45 - 12:45	D@ta
Semiconductors 2	Tuesday, February 25, 2020	15:45 - 17:45	Boole
<i>Instructions</i>	<i>Thursday, February 27, 2020</i>	<i>10:45 - 12:45</i>	<i>Pulse-Hall 8</i>
Semiconductors 3	Monday, March 2, 2020	10:45 - 12:45	D@ta
Electronics 5	Tuesday, March 3, 2020	15:45 - 17:45	Ampere
<i>Instructions</i>	<i>Thursday, March 5, 2020</i>	<i>10:45 - 12:45</i>	<i>Pulse-Hall 3</i>
Electronics 6	Monday, March 9, 2020	10:45 - 12:45	D@ta
Semiconductors 4	Tuesday, March 10, 2020	15:45 - 17:45	Ampere
<i>Instructions</i>	<i>Thursday, March 12, 2020</i>	<i>10:45 - 12:45</i>	<i>Pulse-Hall 3</i>
Electronics 7	Monday, March 16, 2020	10:45 - 12:45	D@ta
Electronics 8	Tuesday, March 17, 2020	15:45 - 17:45	Ampere
<i>Instructions</i>	<i>Thursday, March 19, 2020</i>	<i>10:45 - 12:45</i>	<i>Pulse-Hall 3</i>
Electronics 9	Monday, March 23, 2020	10:45 - 12:45	D@ta
Electronics Practical	Tuesday, March 24, 2020	08:45 - 10:45	Tellegen Hall practicumzaal 1
Electronics 10	Tuesday, March 24, 2020	15:45 - 17:45	Ampere
<i>Instructions</i>	<i>Thursday, March 26, 2020</i>	<i>10:45 - 12:45</i>	<i>Pulse-Hall 3</i>
Semiconductors 5	Monday, March 30, 2020	10:45 - 12:45	D@ta
Semiconductors 6	Tuesday, March 31, 2020	15:45 - 17:45	Ampere
<i>Instructions</i>	<i>Thursday, April 2, 2020</i>	<i>10:45 - 12:45</i>	<i>Pulse-Hall 3</i>
Electronics 11	Tuesday, April 7, 2020	10:45 - 12:45	Chip
<i>Instructions</i>	<i>Thursday, April 9, 2020</i>	<i>08:45 - 10:45</i>	<i>Pulse-Hall 3</i>
Electronics 12	Thursday, April 9, 2020	10:45 - 12:45	Pi

Semiconductors

Bottom-up design

Top-down design

Circuits

Exam

Semiconductors

Bottom-up design

Multiple choice

Open book (course books, handouts and the slides)

It is allowed to use a laptop or tablet (IN FLIGHTMODE) to look at the slides and handouts.

Bonus point for completed design assignment, well documented in SLiCAP

Top-down design

Circuits