Introduction

ENGINEER 3N03 Winter 2015 (Prof. Mohamed H. Bakr)

Electronics and Instrumentation

Room: ITB-A219 ext. 24079

E-mail: mbakr@mail.ece.mcmaster.ca

Main Topics

* Diodes
* OpAmps
* MOSFET Transistors
* Introduction to Digital Circuits
* Bipolar Junction Transistors (BJTs)
* Active Filters and Amplifiers

Information about myself

B.Sc. in Electronics and Communication Engineering, Cairo University, Cairo, Egypt with Distinction (honors), 1992

M.Sc. in Engineering Mathematics (Optimization), Cairo University, 1996

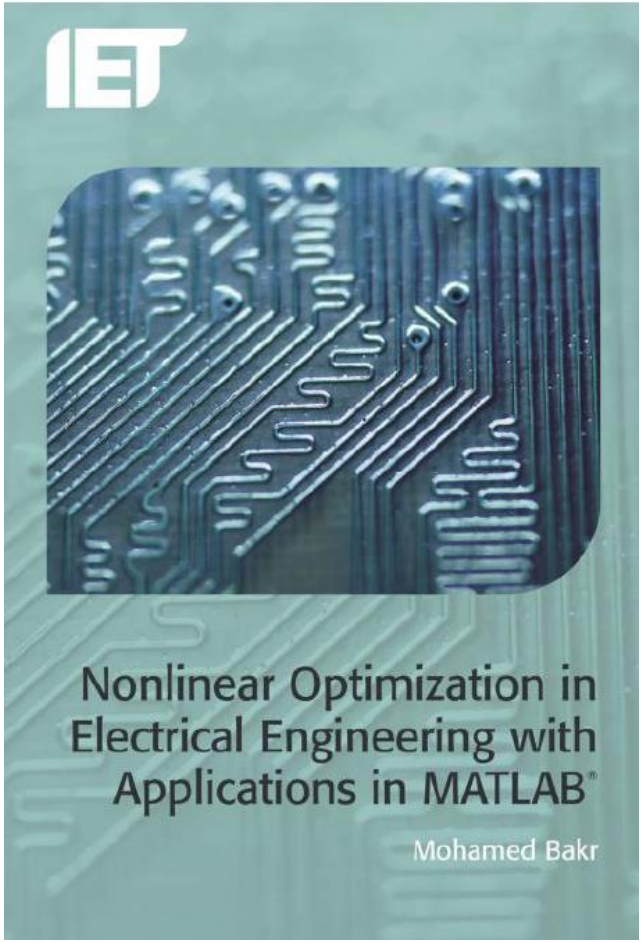
Ph.D. in Computer Aided Design (CAD) of Microwave Circuits, McMaster University, 2000

P.Eng., Ontario, 2003

Author/coauthor of over 220 journal and conference papers, two book chapters, one book, and two patents

Nonlinear Optimization Book

Formulating engineering design as an optimization problem. Showing how to obtain an optimal design through different techniques.



Information about myself (Cont'd)

Research Areas: Optimization methods, computer-aided design and modeling of microwave circuits and photonic structures, neural networks applications, computational electromagnetics, bioelectromagnetism, and nanophotonics

Awards/Scholarships:
TRIO Student Internship in OSA, inc. 1997
Ontario Graduate Scholarship (OGS) 1998-2000,
NSERC PostDoctoral Fellowship 2000-2001,
Premier's Research Excellence Award (PREA) 2003-2009,
McMaster Tenure 2007
NSERC DAS Award, 2011
Full Professor 2013
Co-recipient of Chrysler's 2014 innovation award

Information about myself (Cont'd)

Courses taught:

ECE 750 Advanced Engineering Electromagnetics
EE 2EI4 Electronic Devices and Circuits
EE 3TP4 Signals and Systems
ECE 757 Numerical Techniques in Electromagnetics
EE 2EI5 Electronic Devices and Circuits
EE 3FI4 Theory and Applications in Electromagnetics
EE 2FH3 Electromagnetics I
EE 2CI5 Introduction To Electrical Engineering
EE 3FK4 Electromagnetics II
ECE 733Nonlinear Optimization for Electrical Engineering
EE 4OI6 Engineering Design
EE 4BI6 Biomedical Engineering Design

Associate editor of three journals

Texts

Recommended text

1- Thomas L. Floyd, Electronic Devices (Electron Flow Version), 9th Edition

2. Course webpage

http://www.ece.mcmaster.ca/faculty/bakr/ENG3N03/ENG3N03_Main_2015.htm

Supplemental Material

1- Giorgio Rizzoni, Principles and Applications of Electrical Engineering, 5th edition.

2- A collection of readings and videos to be suggested by instructor.

Grading

Final exam: 50 %

Midterm exams: 20 %

First Midterm February 25th, 6:30 pm-8:30 pm

Second Midterm March 24th, 6:30 pm-8:30 pm

5 Quizzes: 10 % (one per week. Best 5 will be picked)

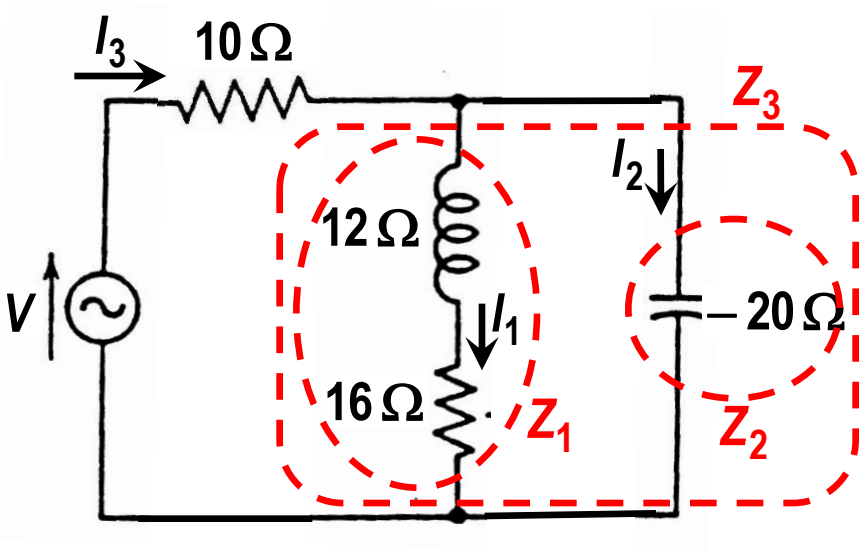
4 Labs 10%

Project: 10% (5% more bonus)

Failure on the final exam means failure of the course!

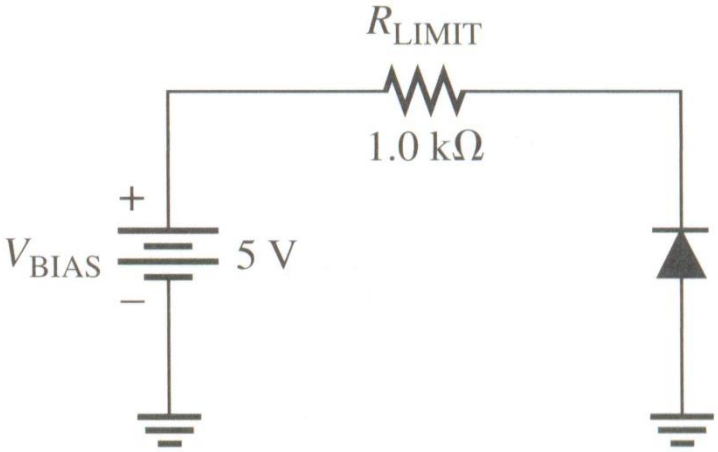
all grades final unless error in marking proven

Circuit Analysis



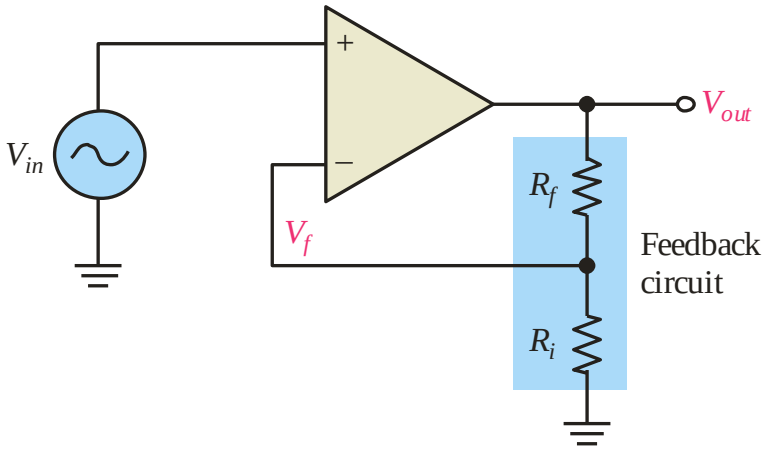
Review of basic circuit analysis concepts needed for this course

PN Junctions



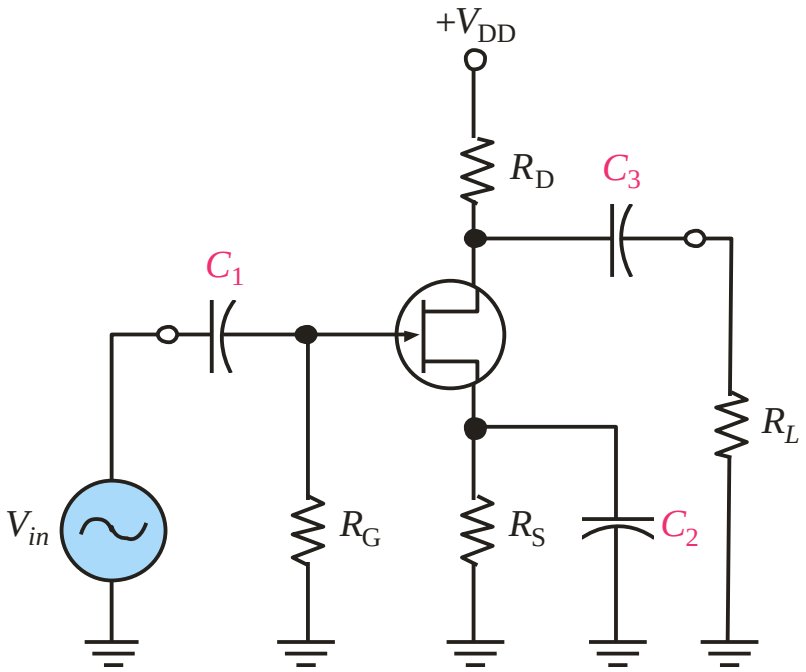
PN junctions, their structure, circuit analysis, and applications

Operational Amplifiers



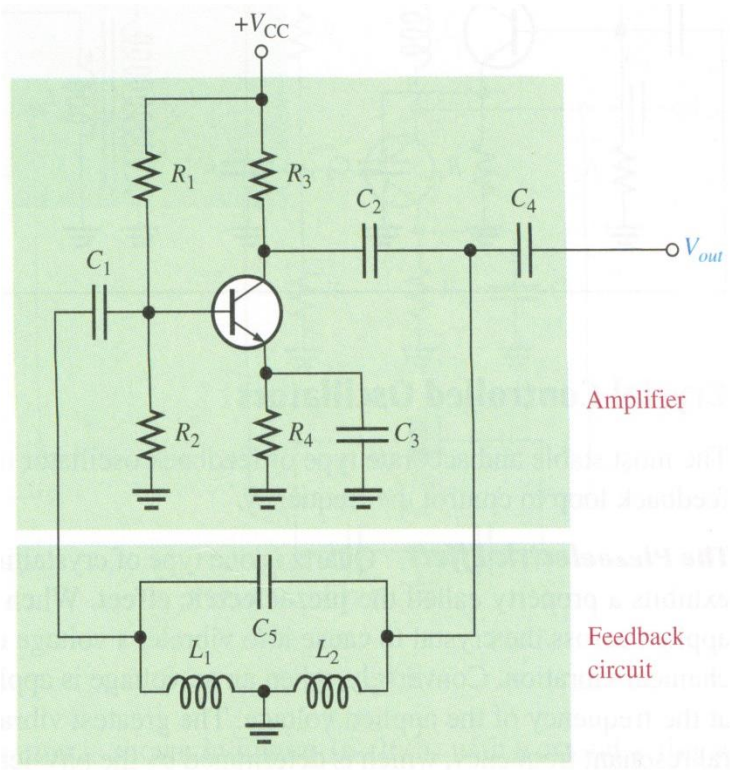
ideal OpAmps, circuit analysis using OpAmps, different applications of OpAmps

Field Effect Transistors (JFETs and MOSFETs)



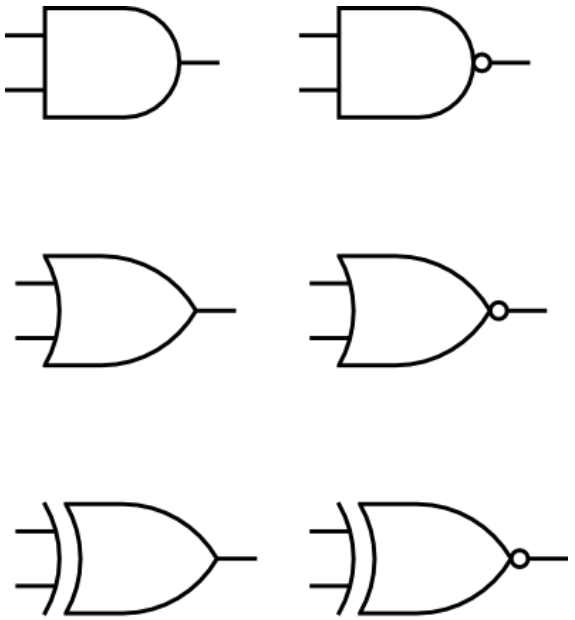
structure, modes of operations, I-V curves, transistor parameters, circuit analysis, biasing, small signal analysis, applications

Bipolar Junction Transistors (BJTs)



structure, modes of operations, I-V curves, transistor parameters, circuit analysis, biasing, small signal analysis, applications

Introduction to Digital Circuits



Basic logic functions, truth tables, implementation of logic tables, applications

Detailed Lecture Tables

Date	Lecture	Description	Chapter
Jan 5th	0	**Organizational Meeting**	
Jan 7th	1	**Basic Concepts:** conductors, insulators, and semiconductors, charges and electric field, voltage difference	
Jan 8th	2	**Circuit Theory 1:** Kirchhoff's voltage law, examples Electric current, Kirchhoff's current law, electric power, Ohm's law	
Jan 12th	3	**Circuit Theory 2:** Thevenin Theorem, Norton Theorem, Capacitors and their response, inductors and their responses, transient analysis, examples on transient analysis	
Jan 14th	4	**Circuit Theory 3:** Phasors, impedances and admittances, phasor diagrams	
Jan 15th	5	**Circuit Theory 4:** combination of elements, filters	
Jan 19th	6	**Semiconductors:** Valence bonds, conduction band and valence band, doping, N-type and P-type materials, examples	
Jan 21st	7	**PN Diode 1:** Structure, Depletion region, different bias conditions, IV characteristics, example	
Jan 22nd	8	**PN Diode 2:** Diode model, half-wave rectifier, full-wave rectifier, bridge rectifier, examples	

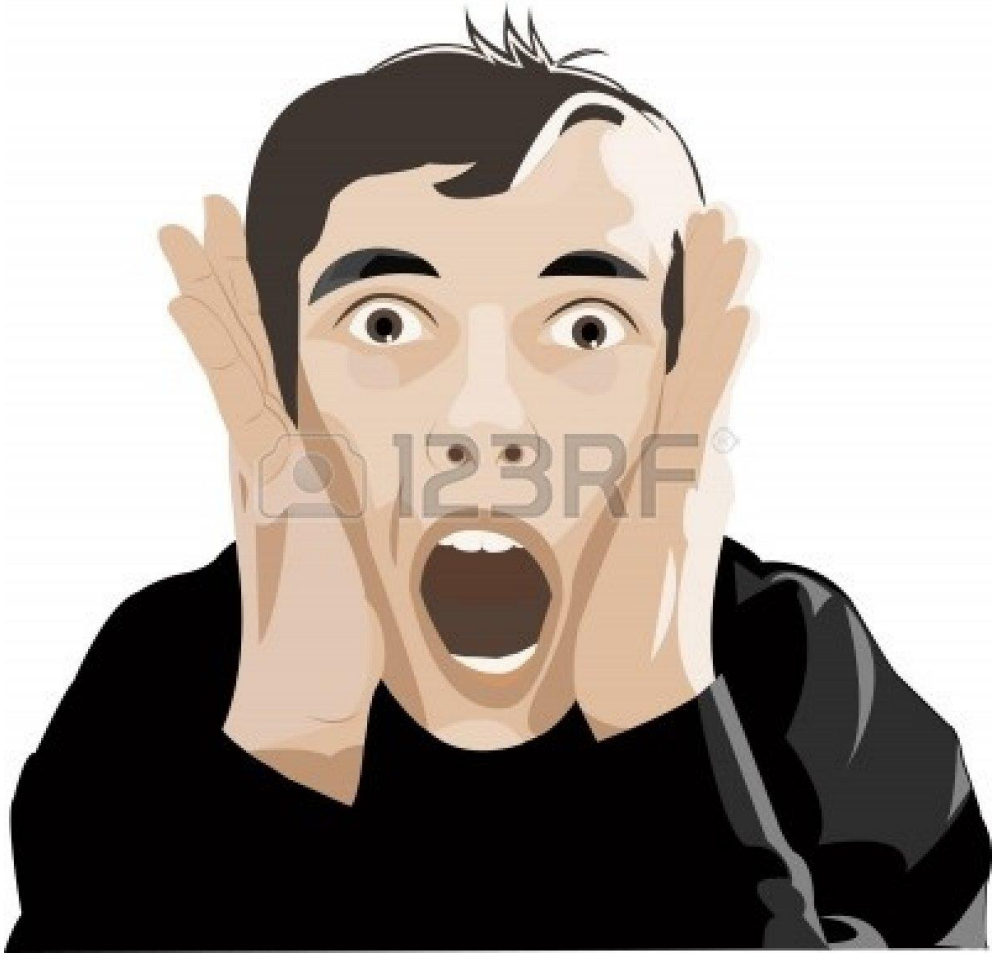
Detailed Lecture Tables (Cont'd)

Jan 26th	9	**PN Diode 3:** Avalanche breakdown, Zener breakdown, examples	
Jan 28th	10	**Operational Amplifiers (OpAmp) 1:** ideal operational amplifier, realistic operational amplifier, parameters of an OpAmp, Applications of OpAmps	
Jan 29th	11	**Operational Amplifier 2:** Inverting amplifier, non inverting amplifier, differential amplifier, examples	
Feb 2nd	12	**Operational Amplifier 3:** Voltage follower, general OpAmp circuits	
Feb 4th	13	**OpAmp 4:** ideal integrator, ideal differentiator, examples	
Feb 5th	14	**OpAmp 5:** Examples	
Feb 9th	15	**Field Effect Transistors (FETs) 1:** JFET structure, JFET operation	
Feb 11th	16	**FETs 2:** MOSFET structure, Characteristics and parameters, Biasing of MOSFET, examples	
Feb 12th	17	**FETs 3:** JFET Common Source Amplifier, MOSFET Common Source Amplifier, Examples	
February 16th-February 21st, Reading Week			
Monday February 23rd, at 6:30 pm, First Midterm			
Feb 23rd	18	**FETS 4:** Common Drain Amplifiers, Common Gate Amplifiers, Examples	
Feb 25th	19	**Digital Circuits 1:** Analog and digital signals, differences between analog and digital circuit, logic levels	
Feb 26th	20	**Digital Circuits 2:** Binary numbers, AND gate, OR gate, examples	

Detailed Lecture Tables (Cont'd)

March 2nd	21	**Digital Circuit 3:** NAND gate, NOR gate, XOR gate, examples	
March 4th	22	**Digital Circuit 4:** binary tables, synthesis of logic functions, examples	
March 5th	23	**Digital Circuit 5:** Half adder, full adder, examples	
March 9th	24	**Bipolar Junction Transistor (BJT) 1:** Transistor structure, I-V characteristics	
March 11th	25	**BJT2:** Modes of operation, voltage and current analysis, examples	
March 12th	26	**BJT3:** Transistor as a switch, transistor as an amplifier, small signal parameters	
Monday March 16th, at 6:30 pm, Second Midterm			
March 16th	27	**BJT and MOSFET:** Applications and examples	
March 18th	28	**BJT and MOSFET:** Applications and examples	
March 19th	29	**Active Filters 1:** examples of active filters	
March 23rd	30	**Active Filters 2:** examples of active filters	
March 25th	31	**Applications**	
March 26th	32	**Applications**	
March 30th	33	**Applications**	
April 1st	34	**Applications**	
April 2nd	35	**Applications**	

Surprise!



123rf.com

Flipped Classroom

You are part of an experiment in engineering education

I will not be teaching! You will be learning. My rule is to guide your learning experience (from the sage on stage to the guide on the side)

All lectures in video will be available on YouTube, the night before our class

You will spend around 50 minutes listening to the lecture before coming to the classroom. You will read the corresponding part in the textbook and attempt to solve drill problems.

We will have discussions on more problems and practical applications in the classroom

Flipped Classroom (Cont'd)

Groups of 4 to be seated together (to facilitate discussions)

I will pose a problem and ask groups to discuss possible solution during the class. Will help in discussions.

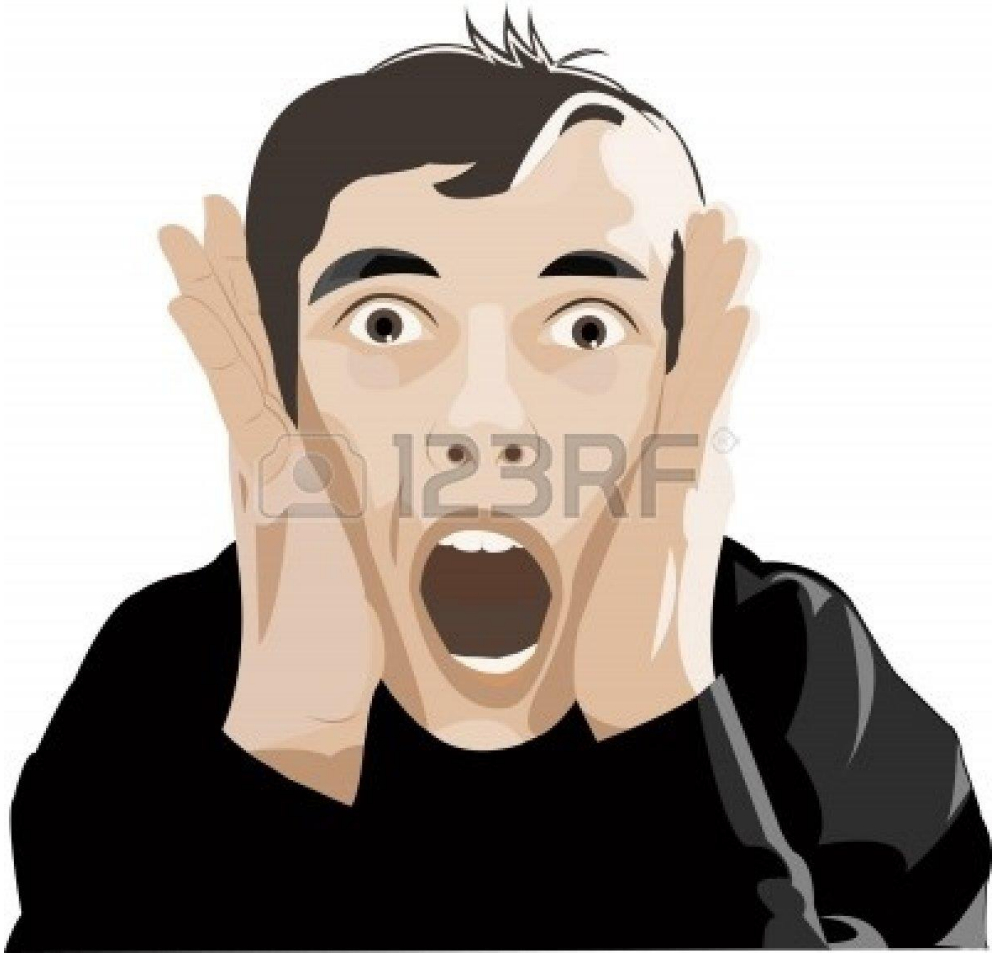
A group is then picked to present their solution and I will comment on this solution

I will present as many practical applications as possible

We will effectively have 3 tutorials per week!

Exams will be mostly based on problems solved in the classrooms/tutorials

A second surprise!



Experiential Learning

the same approach used in EE4OI6 is adopted in your project (10%-15% of your total grade)

I will assume in this project that you are employees in ENGINEER 3N03 Inc.

you are asked to research, simulate, and design an electronic circuit with many components

you will form groups of 4 (same groups of classrooms) to work together on this project

15-minutes biweekly meetings to assess your progress

Video presentations and proposals to the whole class at the end of the project

Experiential Learning (Cont'd)

we will use the free Multisim for simulations

possible topics of your projects: Active Filters, Multi-stage amplifiers, oscillators, sensors, or any other applications in your field

5% bonus for any group who will also build their circuit and measure it

Studying EM: Rules of Survival

Listen to lecture before classroom and read corresponding book material.

10 in-class quizzes (one per week) and the best 5 will be picked. Solve quiz at the end of each YouTube lecture!

Do not miss classrooms or tutorials

Attend all project-related meetings

DO NOT TRY TO REMEMBER ALL FORMULAS – Remember only definitions and fundamental physical laws. Try to grasp the physics behind a formula or a solution. You will be allowed cheat sheets in midterms and final exam

Cogito, ergo sum

Exam Formats

Tests and mid-term exam are closed-book exams.
HOWEVER:

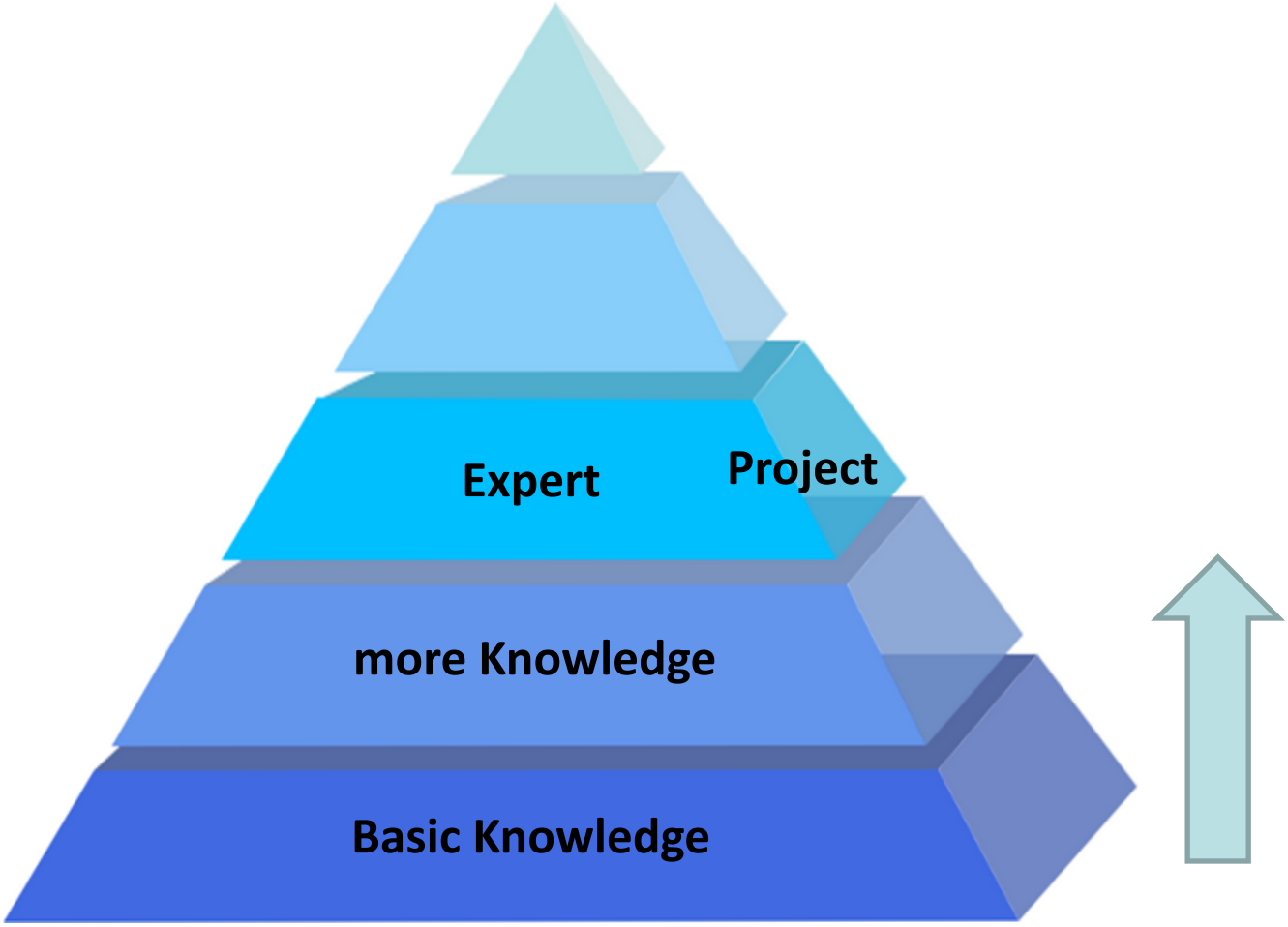
Midterm I: allowed 2 pages (1 sheet, Letter size) of your own writing

Midterm II: allowed 4 pages (2 sheets, Letter size) of your own writing

Final Examination: allowed 4 pages (2 sheets, Letter size) of your own writing

Cheating results in 0 grade and academic dishonesty charges

Course Philosophy



remove course abstractness and connect it to real life

Previous Experiment in Elec. Eng. 2FH3

Total Number of students 215

Those scoring in the A range 70

Those scoring in the A and B ranges 110

Bimodal distribution with big concentration around the C range

Strong correlation between watching videos on time and scoring in the A and B ranges

Finally,…

Office hours?

Any questions?