ECSE-330: Introduction to Electronics
Winter Session, 2008
Course Outline

Welcome!

Course Information

- Professor: Ramesh Abhari

- Lectures: T, Th 8:35-9:55 (ENGTR 0100)

- Office Hours: Tuesday: 10:30 am – 11:30 am,
  Thursday: 10:30 am – 11:30 am,

  Location: 5th floor McConnell (MC519)

- Teaching Assistants:

  Tutorials - Kasra Payandehjoo (Lead TA), Ruiming Chen

- Web page: WebCT (Course material will be posted starting Jan. 3rd)

Tutorials

- Tuesday: 4:05 – 4:55   ENGTR 2110 – Kasra Payandehjoo

- Monday: 8:35am – 10:25am   ENGTR 0060 (50 minutes to be determined during the tutorial)

- Tutorials will start on January 14th

- TAs Office Hours: will be announced during the week of January 14th)

- Students are *assigned* to a tutorial section based on their registration record for the purpose of writing the first two quizzes:
  - You must attend the tutorial that you have registered for in order to write the quizzes.
  - Students who are not in the name list of the tutorial cannot write the quiz.

- If you have any problem about your tutorial schedule you should notify the professor by January 10th

Grading

- Three Quizzes (4% each)   12%
  - Quiz #1: 28, 29 - Jan. @ last 45 minutes of tutorial
  - Quiz #2: 10, 11 - March @ last 45 minutes of tutorial
  - Quiz #3: 3 - April @ 8:30 – 10:00 (during the lecture)
- SPICE assignment   6%
- Assigned problems   self assessment
- Midterm #1   (During the lecture)   16%
  - 14 - Feb @ 8:30 – 10:00
- Midterm #2   (During the lecture)   16%
  - 25 - March. @ 8:30 – 10:00
- Final Exam (during examination period)   50%
- *The grading scheme is not negotiable and will not be altered at anytime during the course*

Quizzes

- Quiz 1 and Quiz 2:
    - 45 minutes long
    - Different tutorial sections write different quizzes
    - At least one question is based on a problem-set question
    - Students MUST write quizzes in their assigned tutorial section
- Quiz 3:
    - 45 minutes long
    - During the lecture

SPICE Assignment

- Introduction to SPICE will be given during the tutorials

- SPICE notes will be posted on the WebCT

- Problems from SPICE book will be recommended for this assignment

- Students work in groups of one, two or three on the assignment

- SPICE assignment

  - Will be posted during the week before the study break on WebCT

  - Due by April 10th at 4:00pm

  - The report should be dropped in the assignment box located at the Trottier building beside the undergraduate Office

Midterms

- Two class tests will be given

- Exams are all closed book and closed notes

- 4 problems

- A formula sheet will be given

- The majority of the problems will be numerical, with a few conceptual and descriptive questions.

- Examples of previous year's tests will be available on WebCT prior to the exams.

- The Faculty of Engineering Standard calculator is the only calculator that may be used for the quizzes, the midterms and the final exam.

Assigned Problems – Self Assessment

- Will be posted on WebCT throughout the term

- Will not be collected or graded

- Sources for questions:

  - Textbooks

  - Quizzes and exams from previous terms

- Solutions:

  - Will be posted on WebCT

  - Tutorials

Final Exam

- Carries 50% of the total course mark

- 6-8 long problems

- A formula sheet will be available for this exam

- A review session will be scheduled before the start of final exams.

- Review tutorial session will be scheduled before the exam

- To do well on the final exam, it is recommended that you:

  – Attend lectures and tutorials

  – Complete assigned problems

  – Complete SPICE assignment

Re-Grading

- Requests for re-grading quizzes, class tests (Midterms) and SPICE assignments must be made *within one week* of their return to the students.

- For Midterm re-grades, see Prof. Abhari

- For quiz and SPICE assignment re-grades, see the TAs

- Missing midterms or quizzes for medical reason:
    - A note from the doctor should be presented to the professor *within one week* from the test.
    - The notes should *clearly indicate the time and the date* and it should specifically state that the student was not able to attend the exam.
    - The weight of a missed exam/quiz is transferred to the final exam.

Course Text Books

- Pre-Requisite:
  - ECSE-210 Circuit Analysis

- Main Text:

  Microelectronic Circuits, A. Sedra/K.C. Smith, Oxford University Press, 5th edition, 2004. This book will be referred to in the course notes as S&S.

- Supplementary Text:
  SPICE, G.W. Roberts & A. Sedra, Oxford University Press, 2nd edition, 1997.
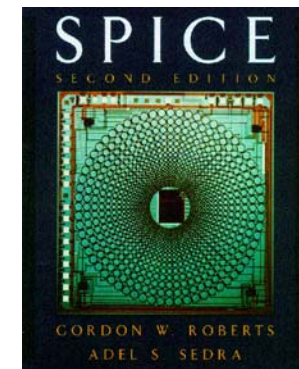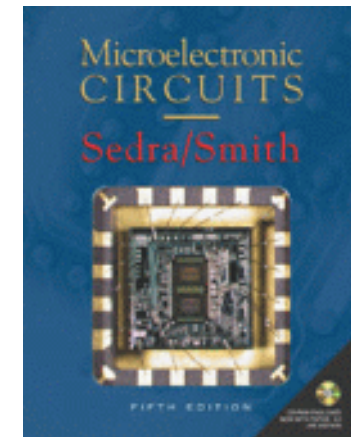
Use WebCT to:

- Download lecture notes
- Read the course bulletin board for important announcements
- Get solutions to the assigned problems
- Get solutions to exams and quizzes
- Check the course outline and calendar

Academic Integrity

- **McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see http://www.mcgill.ca/integrity for more information).**

View Graphs

- Lecture notes (handout slides) will be made available to the class throughout the semester via WebCT.

- Content will be divided by section.

- Complete handout slides will be posted on Web

- This should NOT affect attendance. There will be problems worked on the board which often show up in the exams

# What You Already Know (ECSE-210)

- Circuit models – resistors, capacitors, inductors

- KVL and KCL

- Branch relationships

- Resistive circuit analysis

- Network theorems including one and two port networks

- Steady state, transient and frequency analysis

What We Will Cover

Chapter 1)   **Introduction to Analog and Digital Electronics**

(2 lecture)   *Sections 1.4, 1.5, 1.6, 1.7*

Chapter 3)   **The PN Junction and Diodes**

(4 lectures)   *Sections 3.1-3.7*

Chapter 4)   **Field-Effect Transistors**

(8 lectures)   *Sections 4.1-4.10, (also 10.3, 6.3)*

Chapter 5)   **Bipolar Junction Transistors**

(8 lectures)   *Sections 5.1-5.10, (also 6.3)*

Chapter 2)   **Operational Amplifiers**

(1 lecture)   *Sections 2.1-2.8 (briefly)*

Circuits We Deal With?

- Contain Nonlinear components
- That is the main difference with what you have seen before
  - FEE (ECSE200), Circuit Analysis (ECSE210) and Measurement Lab (ECSE291): all Linear Circuits
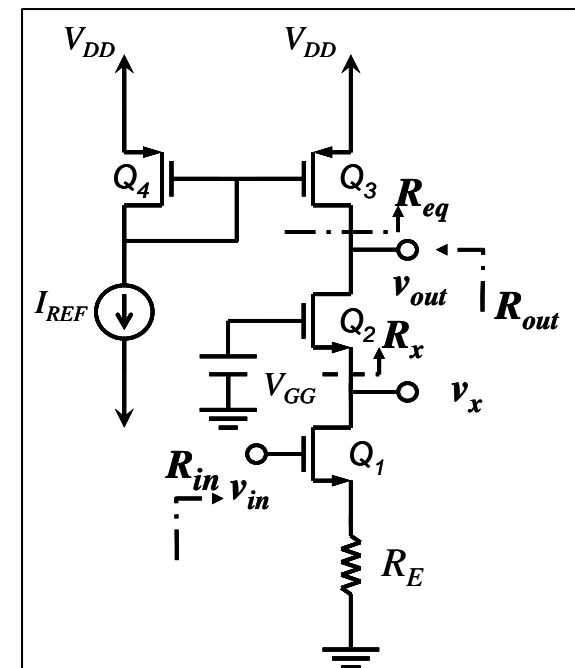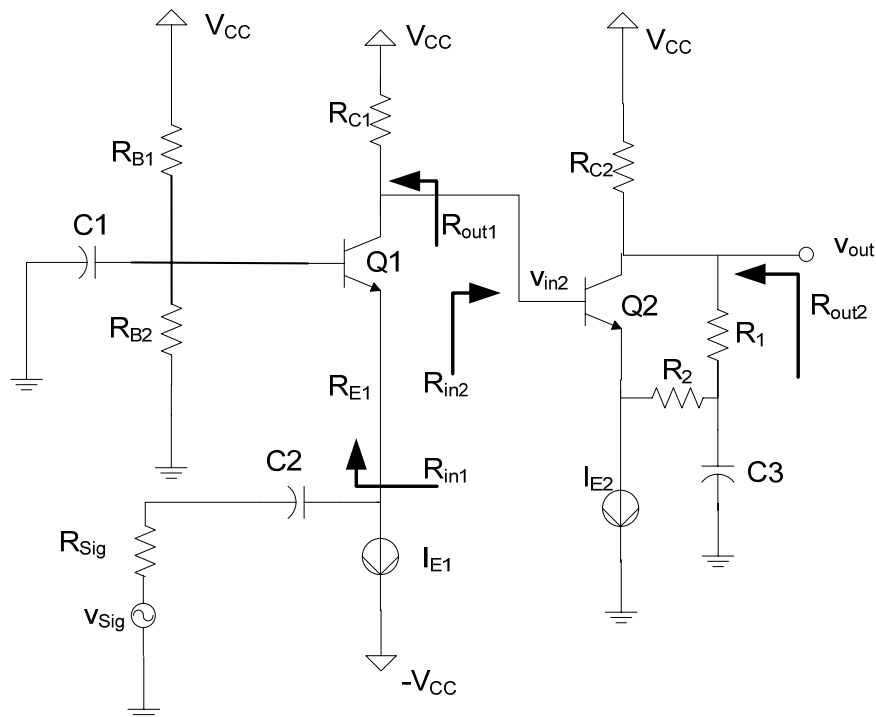

k_n = 100μA/V
W/L = 50
λ = 0.01V^{-1}
V_{t0} = 1V

V_{DD} = 6V
R_D = 1kW
V_{GS} = 2V
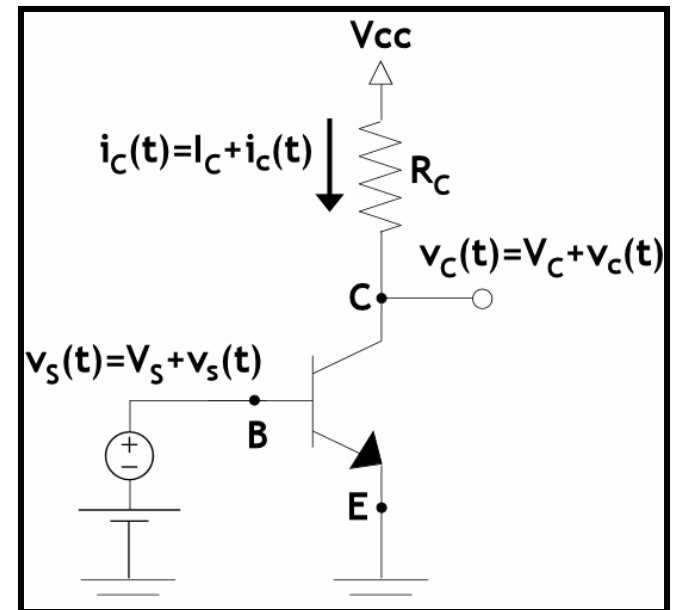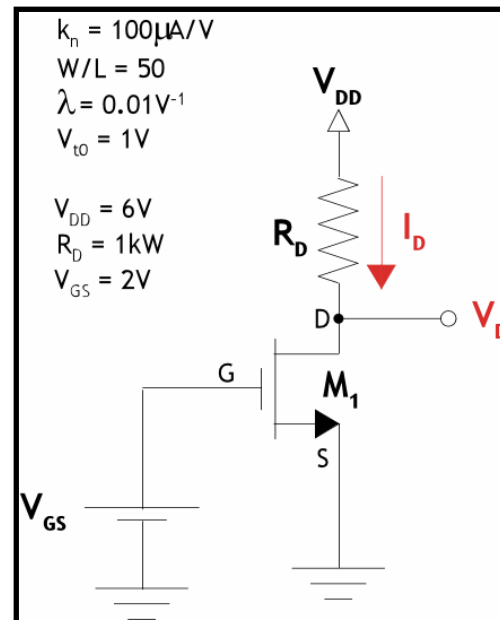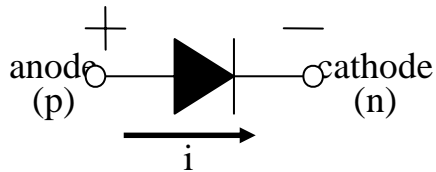
What We Often Look for?

- What is the voltage gain?

- What are the input/output impedances?

- What is the physics of operation?

- How can we model the nonlinear device?

Multi-Stage Circuits

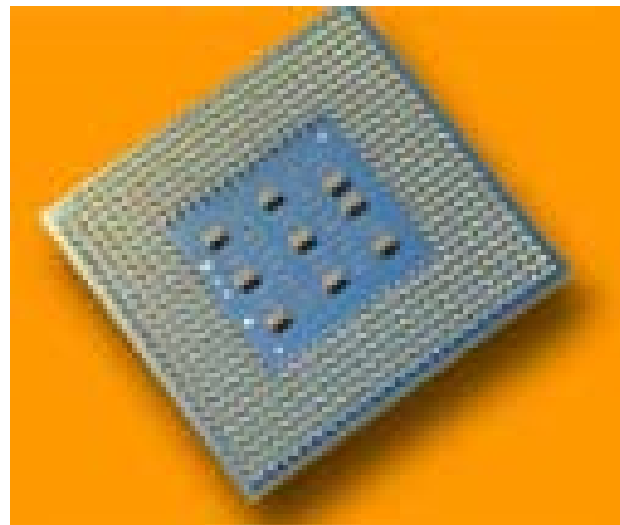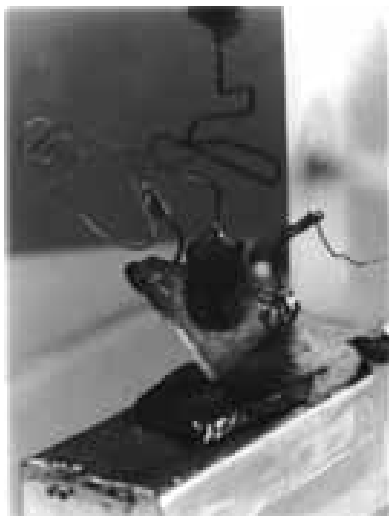- Multiple stages of these nonlinear circuits

- With learn a systematic method to solve the problem
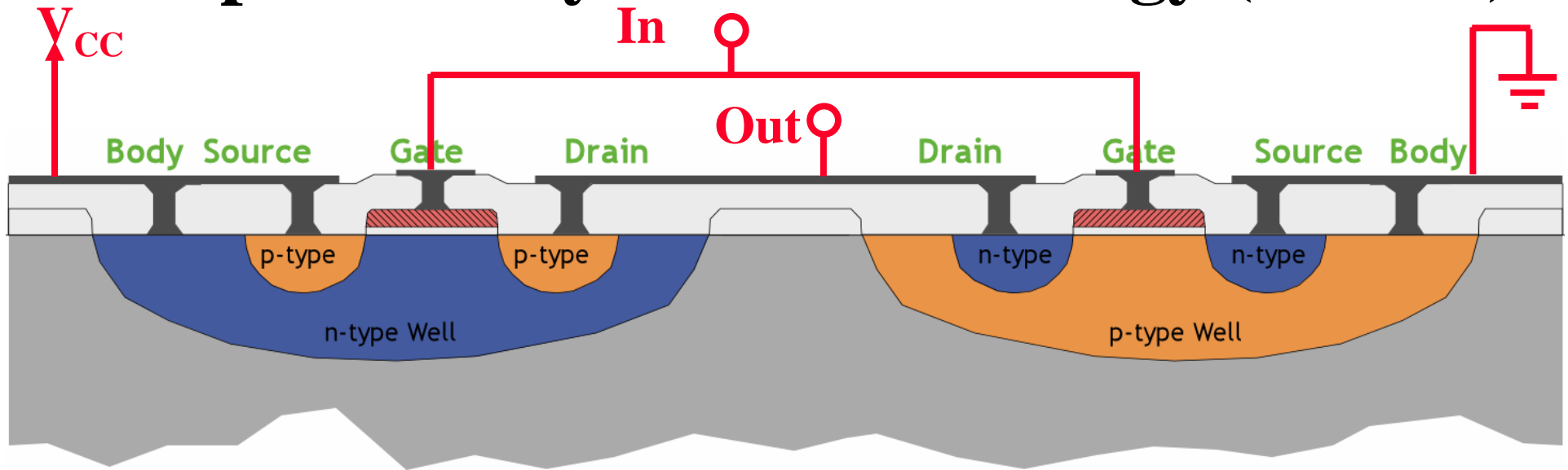
Upon Completion of the Course

- Design and analysis (DC and Small Signal) of circuits:
    - Rectify signals – diodes
    - Amplify signals – analog functions
    - Digital circuits – digital signal processing
- Design principles behind the realization of modern Integrated Circuits (ICs)
- An understanding of physical principles behind the operation of transistors and diodes
- Everything you need to know for ECSE-334, Electronic Circuits II and its Lab.

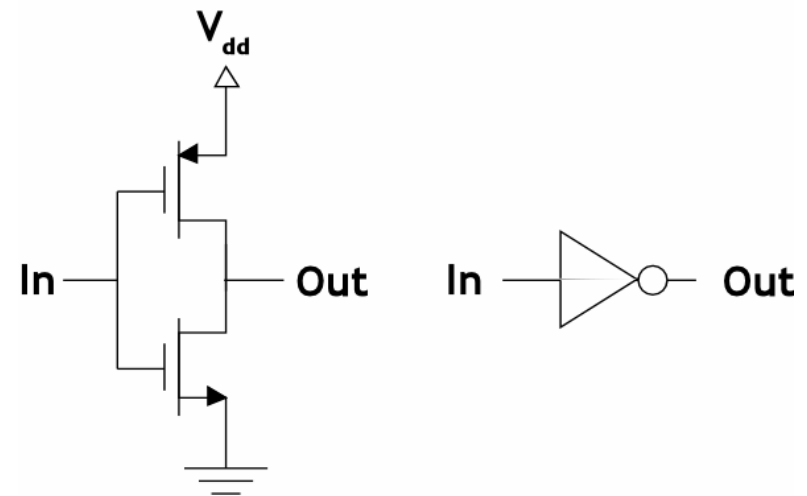# What's the big deal about a transistor?

- The 1st transistor was invented in 1947 at Bell Labs by Brattain and Bardeen.

- Moore's law: An exponential growth in the number of transistors per integrated circuit exists, i.e. doubles every couple of years.

- Intel 4004 processor in 1971 had 2,250 transistors, And now?

  - The Pentium IV with 55 million transistors

- These transistors are located in an area of ~12 mm x 12 mm

Complementary MOS Technology (CMOS)

V$_{CC}$

In

Out

Body Source Gate Drain Drain Gate Source Body

p-type p-type n-type n-type

n-type Well p-type Well

V$_{dd}$

- Example: CMOS technologies
- These structures have become smaller and smaller through the years.

In — Out   In ▷o Out

What's the big deal about a transistor?

- Intel's first processor ran at 108 KHz. The Pentium IV processor runs at 3.8GHz.

- If automobile speed had increased similarly over the same period, you could drive from San Francisco to New York in 13 seconds.
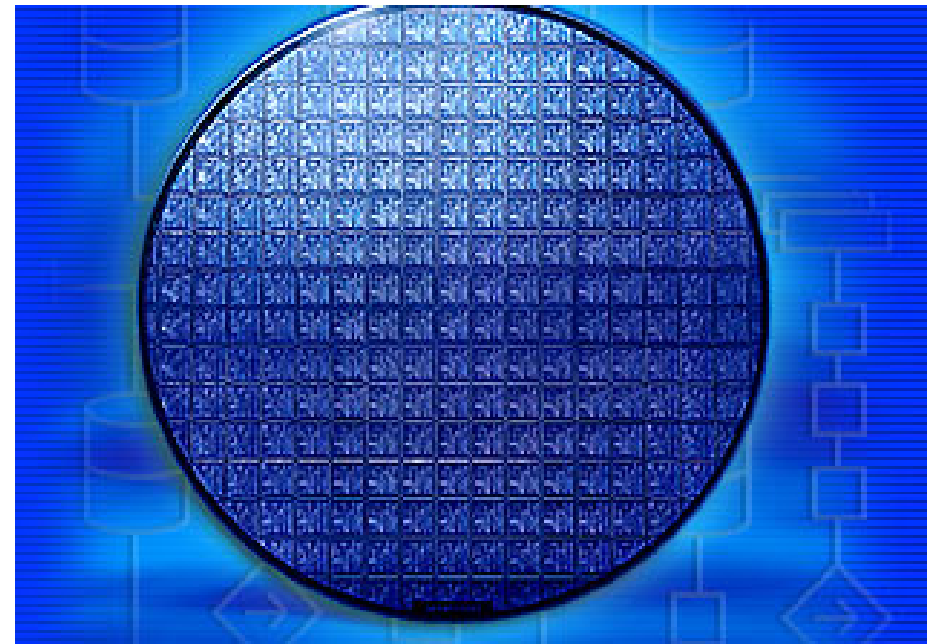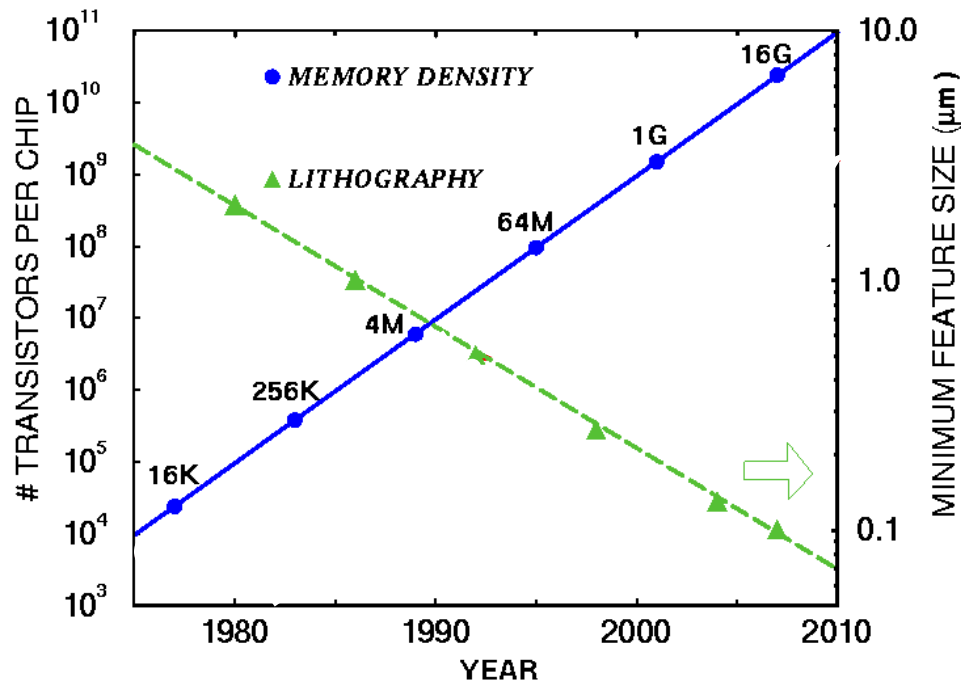
A Final Remark

- Expectations from the students during the lecture:
  - *When I am speaking, you are listening*
  - *I will not tolerate a disruptive classroom*
  - *There will be opportunities for questions*
  - *Please be respectful*

Before the Next Class

- Review the prerequisite material

- Download slides for Chapter 1 (available by Monday, January 7th, 2008):

  - Introduction to Analog and Digital Electronics from S&S,

  - Begin reading S&S