Welcome to ENEL469: Analog Electronic Circuits

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Continuation to 361

Learning Objectives

At the end of this course students will be able to:

- Design and analyze BJT biasing circuits for single stage and multistage amplifiers
- Design and analyze various current mirror circuits and current steering circuits
- Explain the operation of a differential circuit with active loads
- Design and analyze various power amplifiers
- Explain each block of practical operational amplifier circuits
- Design practical analog electronic circuits

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Grade Determination

Assignments	15%
Quizzes	40%
Lab Studies	15%
Participation	5%
Project	15%
Midterm	10%

- no final exam, there will be a midterm at the end of term

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- Any 2 will be picked to be evaluated for correctness, the rest will be for effort
  Just do all of assignment questions correctly

Assignments (15%)

- The assignments will be given via D2L
- All submissions are via D2L
- Students are required to upload neat and complete handwritten solutions in .pdf format
- All questions in a given assignment may not be graded
- This is not a group assignment
- Students missing a deadline will receive an automatic zero

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Lab Studies (15%)

- There are 4 labs in this course
- Students will work in groups of 4
- Multisim will be required for lab studies
- No formal lab report is required, but students may need to upload their worksheet for evaluation.
- TAs will evaluate students' work/understanding by asking relevant questions during the lab. There may be additional tests (like short quiz) for evaluating the lab work.

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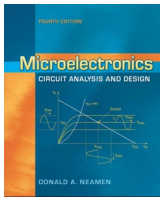
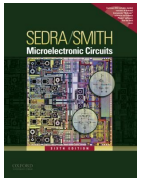
- there will be pre-labs

No Required Textbook for ENEL469

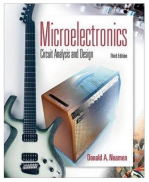
Microelectronic
Circuit Analysis and Design
Donald A. Neamen
4th Edition



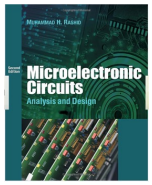
Other books



Microelectronic Circuits
A. Sedra and K. Smith
5th or higher



Microelectronics Circuit Analysis and Design
D Neamen; 3rd Ed



Microelectronic Circuits Analysis and Design
M. H. Rashid, 2nd Ed

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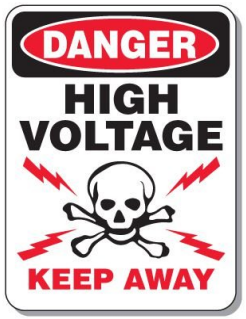
Academic Misconduct

Noooo



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What is Electronics?

A controlled flow of electrons through semiconductor, vacuum, and other typical conducting materials

Normally electrons do not flow through vacuum

How about vacuum tubes (early electronics)

Diode, Triode, Pentode, etc.

Electron discharge and a special arrangement make electrons flow in vacuum

Normally electrons do not flow through semiconductors

How about semiconductor electronics (Silicon Valley)

PN junction, BJT, FET, etc.

Semiconductor doping makes electrons flow in a semiconductor

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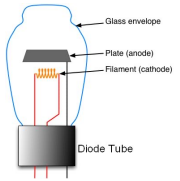
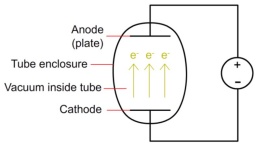
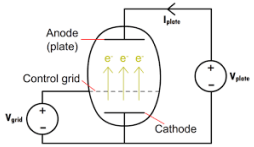
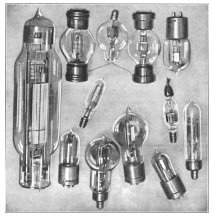
Vacuum Tubes: Early Electronics









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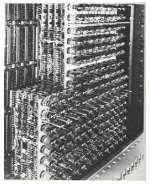
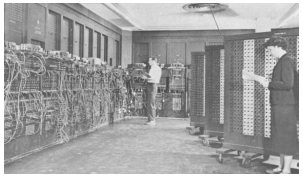
Early Electronics Using Vacuum Tubes





- In 1943-45
- 20’ x 40’ room
- 30 tons
- 18000 vacuum tubes
- 174,000 Watts heat

IBM 701 Calculator, 1952

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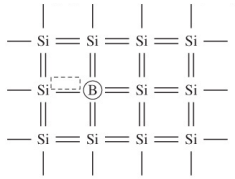
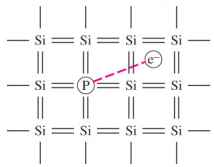
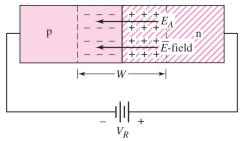
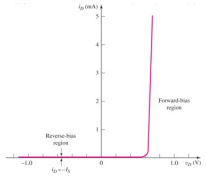
Semiconductor Electronics









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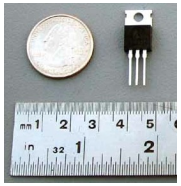
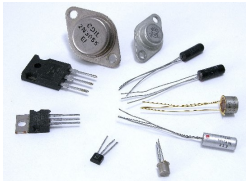
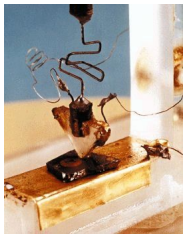
Bipolar Junction Transistor (BJT)







The first transistor, Bell Lab, 1948

Shockley, Bardeen, and Brattain

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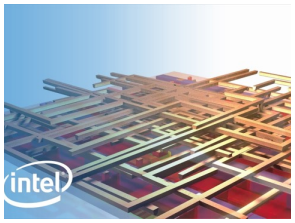
Integrated Circuit



SSI:	Small-scale integration (≈ 10 - 50)
MSI:	Medium-scale integration (few 100)
LSI:	Large-scale integration (≈ 1000)
VLSI:	Very large-scale integration
ULSI:	Ultra large-scale integration (> 1 M)
GSI:	Giga-scale integration (> 1B)

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Three Major Revolutions in Electronics in the Past

Vacuum Tube	Vacuum tubes were invented in many different forms. The first practical vacuum diode was invented in 1904 by J.A. Fleming.
Semiconductor Transistor	Shockley, Bardeen, and Brattain invented the semiconductor transistor in 1948. (Nobel Prize in 1956)
Integrated Circuit (IC)	In 1959 Texas Instruments (J. Kilby) and Fairchild Semiconductor (R. Noyce) received US patents. After a legal battle, Fairchild produced the first commercial IC in 1961. Now making more than $1 trillion in a year.

Present? *and* *future?*

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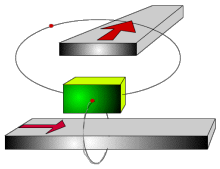
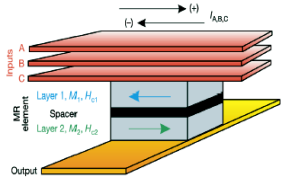
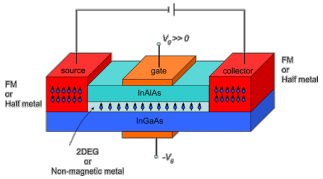
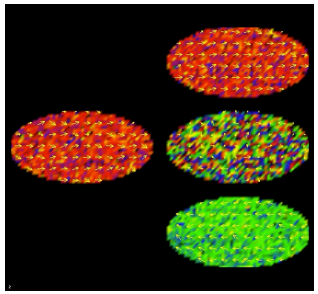
Present and Future Electronics: Spintronics

Also known as Magnetoelectronics









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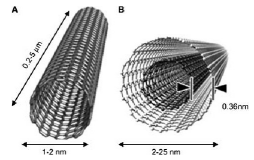
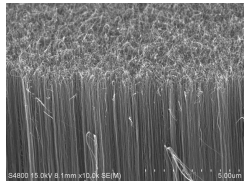
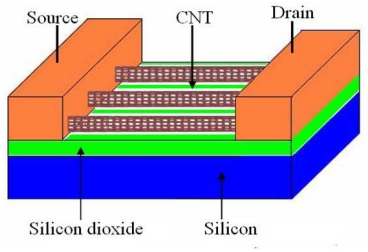
Present and Future Electronics: Carbon Nanotube







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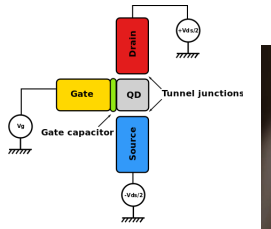
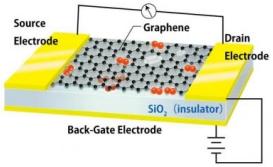
Present and Future Electronics: Graphene





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Present and Future Electronics: Multi Bridge Chanel FET (MBCFET)

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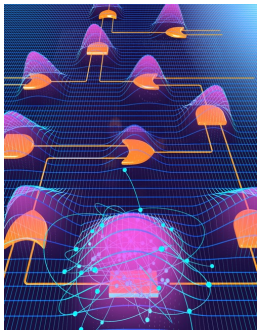
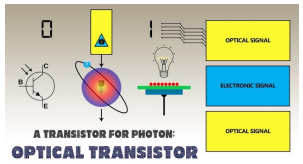
Present and Future Electronics: Optical Transistor



World's first ultrafast all-optical room temperature transistor, IBM Zurich

Nature Photonics, June 2019



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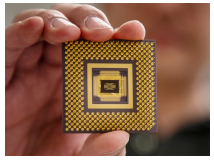
Present and Future Electronics: Memristor



First programable Memristor computer

IEEE Spectrum, July 2019

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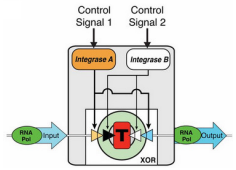
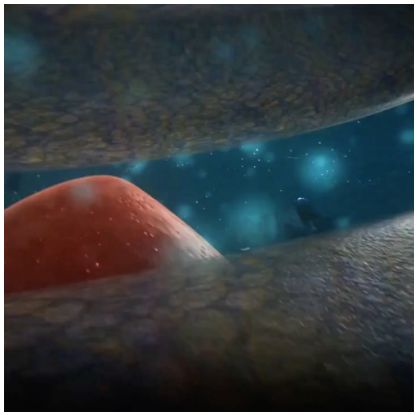
Present and Future Electronics: Biological Computing



Biological computing,
Stanford University

Science, 2013



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Present and Future Electronics

- We are going through a big transition
- We will see big technological shift in electronic devices particularly in the computing devices

What will remain common?

Circuits

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