

ECE113: Basic Electronics

WINTER 2024

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Office Hours:

Will be posted in the classroom!

Teaching staffs

Instructors:

Tammam Tillo

Section A

Sayan Basu Roy

Section B

Teaching Fellow:

Awanish Kumar Singh

Mrityunjoy Kumar Ray

Teaching Assistants

Details will be uploaded in the google classroom soon. .

Early History of Semiconductor Devices

1940's: Vacuum-tube era

- Vacuum tubes were used for radios, television, telephone equipment, and computers
- ... but they were expensive, bulky, fragile, and energy-hungry

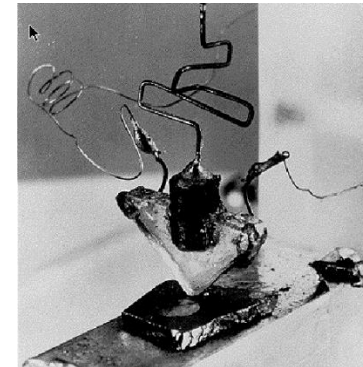
ENIAC-The first digital computer



→ Invention of the point-contact transistor

- **Walter Brattain, John Bardeen, and William Shockley, *Bell Labs*, 1947**
Nobel Prize in Physics 1956

– reproducibility was an issue, however



→ Invention of the bipolar junction transistor (BJT)

- **William Shockley, *Bell Labs*, 1950**

– more stable and reliable; easier and cheaper to make

Discrete Electronic Circuits

- In 1954, *Texas Instruments* produced the first commercial silicon transistor.

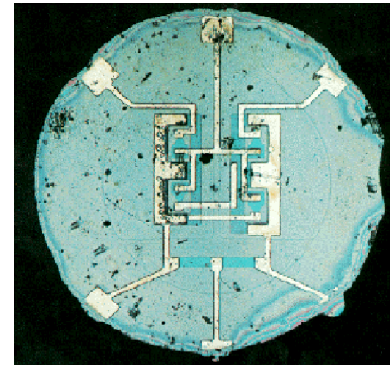
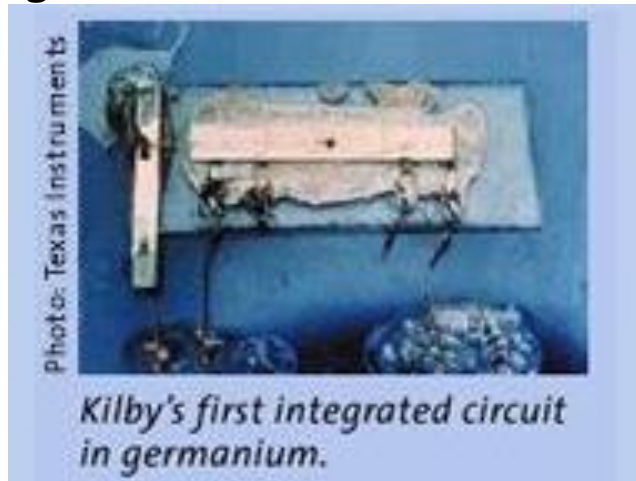


~\$2.50 each

- Before the invention of the integrated circuit, electronic equipment was composed of discrete components such as transistors, resistors, and capacitors. These components, often simply called "discretes", were manufactured separately and were wired or soldered together onto circuit boards. Discretes took up a lot of room and were expensive and cumbersome to assemble, so engineers began, in the mid-1950s, to search for a simpler approach...

The Integrated Circuit (IC)

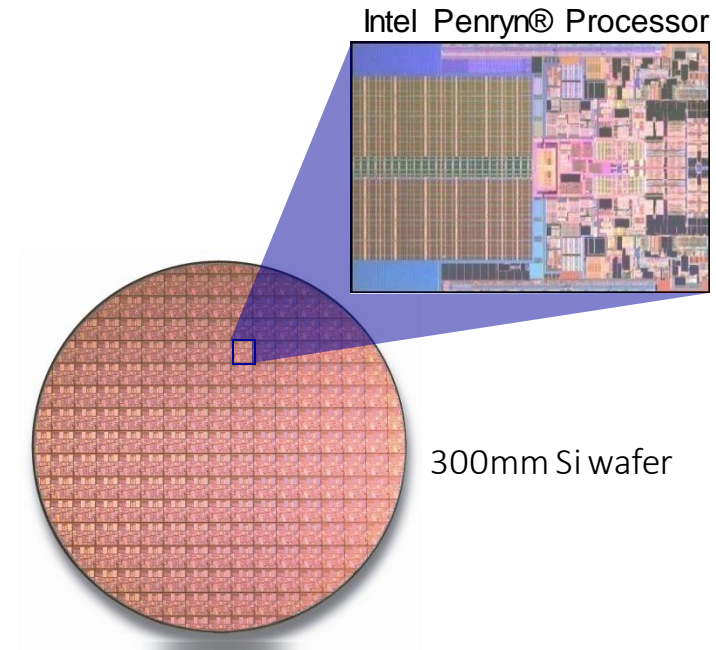
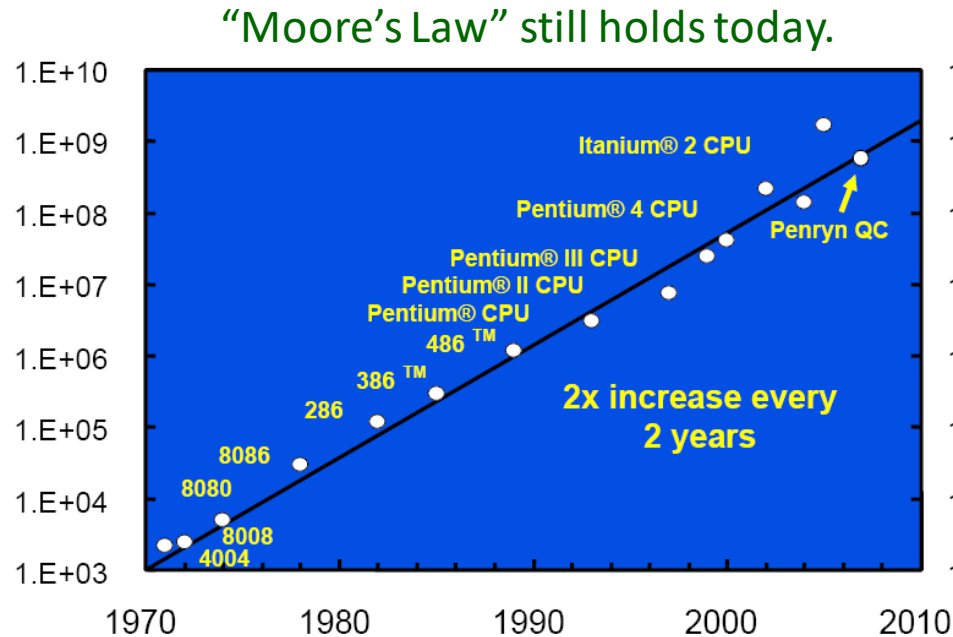
- An IC consists of interconnected electronic components in a single piece ("chip") of semiconductor material.
 - In 1958, Jack S. Kilby (Texas Instruments) showed that it was possible to fabricate a simple IC in germanium.
 - In 1959, Robert Noyce (Fairchild Semiconductor) demonstrated an IC made in silicon using SiO_2 as the insulator and Al for the metallic interconnects.



The first planar IC
(actual size: ~1.5mm diameter)

From a Few, to Billions of Components

- By connecting a large number of components, each performing simple operations, an IC that performs complex tasks can be built.
- The degree of integration has increased at an exponential pace over the past ~40 years.
 - The number of devices on a chip doubles every ~2 years, for the same price.



The Silicon Revolution

- Steady progress in integrated-circuit technology over 40+ years has had dramatic impact on the way people live, work, and play.
- The semiconductor industry is estimated to have more than \$600B/yr in sales in 2024. .



Military



Computers



Communications



Industrial

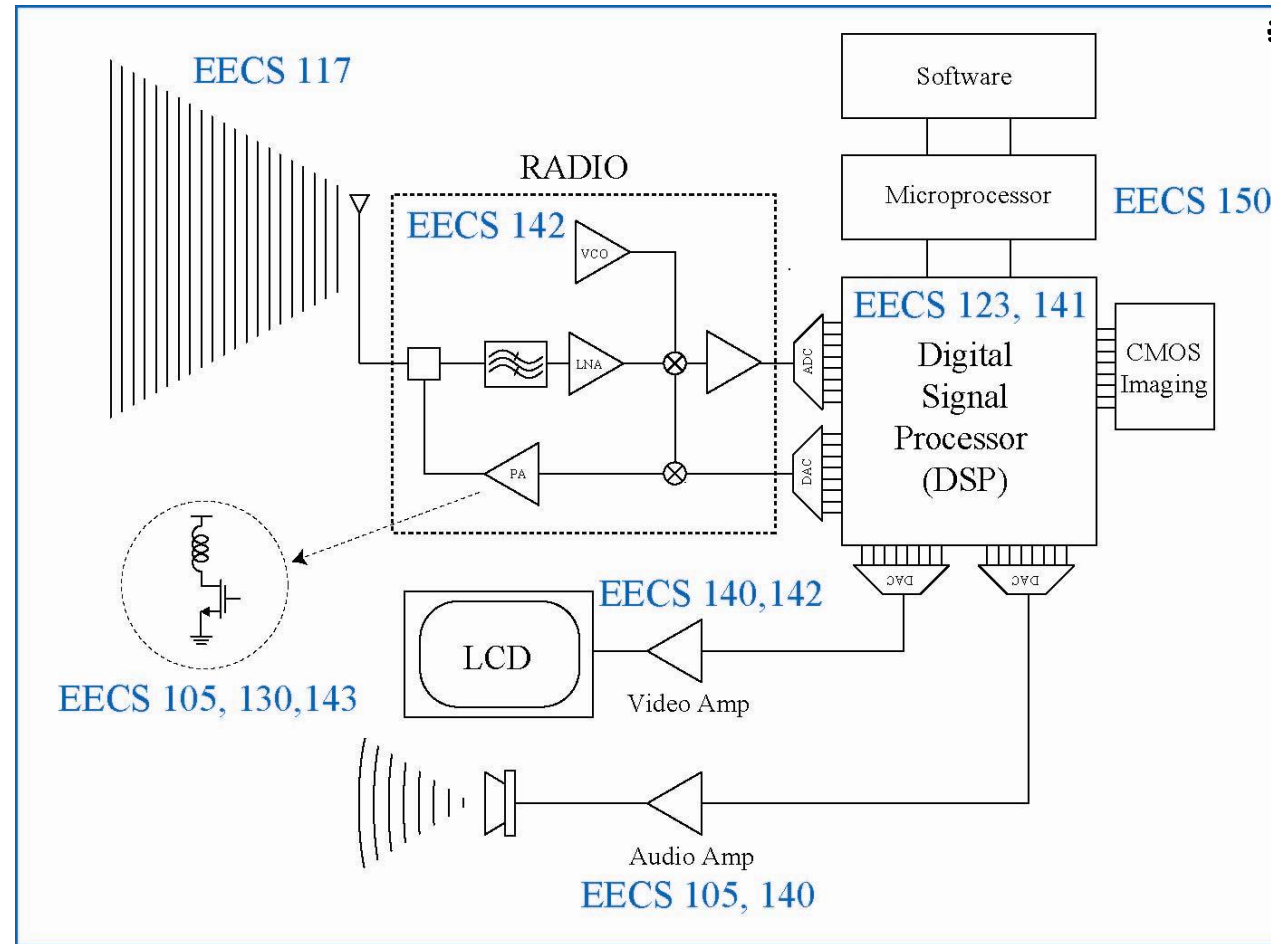


Transportation

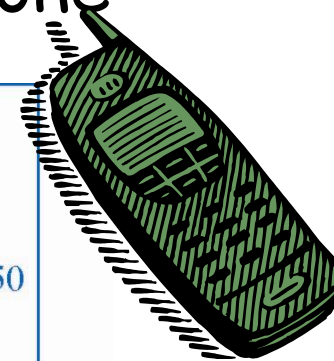


Consumer Electronics

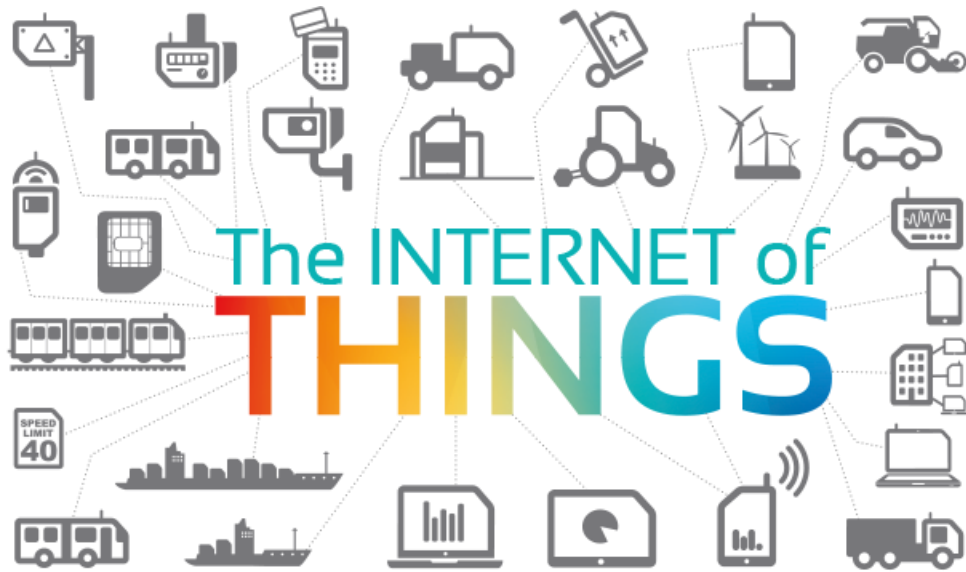
Example electronic system: cell phone



ENTIRE SYSTEM: EECS 120, 126, 121



Motivation



Course Outline

- Basic components of Electrical Circuits: Fundamental Electrical variables - charge, current, voltage and power; independent and dependent voltage and current sources, Ideal circuit elements - Resistor, Capacitor and Inductor. Passive and Active Components, Constitutional relationship - Ohms Law;
- Basic concepts of Analysis of Resistive Networks: Nodes, Paths and Loops, Kirchhoff's Voltage and Current Laws, Series and Parallel connection of Resistances and division voltage and current. Loop and Node Analysis.
- Network Theorems: Thevenin's Theorem, Norton's Theorem
- Superposition Theorem and Maximum Power Transfer Theorem.
- RC and RL circuits' response
- RLC circuits' response
- Concepts of impedance/admittance, Phasors and Representation
- RC, RL and RLC circuits' response to Alternating inputs (the response to alternating input will be handled only under steady state condition)

Course Outline

- Operational Amplifier - Inverting configuration
- Operational Amplifier - Non-Inverting, Integrating and Differentiating configuration
- Diodes: Basic principle, Clipper, Clamper circuits and application
- LED, Zener Diode and Solar Cell
- Half Wave and Full Wave Rectifiers - Wave form and Ripple & its reduction.

- Text books:

William H. Hayt Jr., Jack E. Kemmerly and Steven M. Durbin, *Engineering Circuit analysis*. 8th Edition, Tata McGraw Hill

Smith, Ralph J and Dorf, R C, "Circuits Devices and Systems", 5th Edition, John Wiley and Sons

Reference book

There are many text for Principles of Electrical Engineering

Assessment

- Assignments 15% (two assignments)
- Quizzes 15% (two quizzes)
- Laboratory 20% (2% attendance, 8% lab report/file, 10% lab exam)
- Mid Semester 20%
- End Semester 30%

Course communication

- All the announcements, assignments, lectures, lab materials will be shared through **google classroom**.
- No separate communications shall be done using email, unless necessary.
- Consult course site at **google classroom** regularly

How to Join ECE113- Basic Electronics Section B in google classroom?

- Log on to **google classroom** using your IIITD credentials
- Click on the + sign at the top right corner
- Select join class
- Enter this class code: **nxgzhyt**

Laboratory

- Location: We will have laboratory Session in ECE Labs
- Lab materials will be provided through google classroom
- From next week onward: **prepare for the lab beforehand**
- Lab Engineers with the help of TFs and TAs will manage laboratory

Tutorial

- Location: We will have Tutorial Session once in every week
- Tutorial materials will be provided through google classroom
- TFs with the help of TAs will manage Tutorials

Ground rules

- Be on time
- Ask questions and interact with me if some concepts are not clear!
- Post your questions in the google classroom! Use it as an interactive platform to discuss concepts!
- **IIIT Delhi plagiarism policy** will be strictly followed in this class
- Note that your first point of contacts are TAs; followed by TFs; followed by the Instructor.