



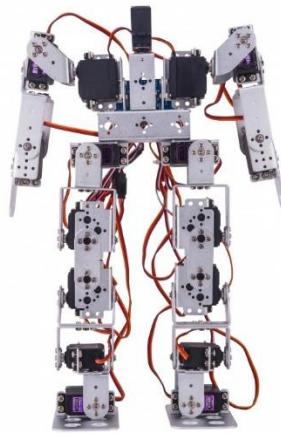
# ECE 101

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## Fundamentals of Electronics



# Life nowadays...



Electronic systems are ubiquitous nowadays.

# ECE-101

**Objective** To impart knowledge of basic principles of electronics to UG students from other disciplines of engineering and science.

## Content, course plan

Contents	
Review of properties of metals, dielectrics and semiconductors.	<b>Op-Amp Applications:</b> Comparator, summing, integrator, differentiator, instrumentation amplifiers, isolation amplifiers, Operational Transconductance Amplifiers, Log and Antilog amplifiers, Converters, Introduction to OPAMP based active filters, Brief description of OPAMP based oscillators.
<b>Diodes:</b> Working principle and characteristics and diode applications (rectification with capacitive filter and <u>zener</u> regulation).	
<b>BJT:</b> Operation and characteristics, brief overview of DC biasing, ' $r_e$ ' model, Amplifier (CE, CB and CC).	
<b>MOSFET:</b> Introduction to MOSFET operation and characteristics.	<b>Basic Digital Electronics:</b> Binary number system, Boolean algebra, Logic gates, adders, one-bit memory, flip-flops (SR, JK), shift registers, asynchronous counter.
<b>Operational Amplifiers:</b> Input modes and parameters, introduction to concept of negative feedback, negative feedback in OPAMP, bias currents and offsets, open and closed loop responses.	<b>Introduction to Microprocessor:</b> Eight-bit microprocessor architecture, stored program computer, instruction set and basic assembly language programming.

# Electronics and Communication Engineering



## Devices

- Transistors
- Diodes
  - Device Physics
  - Circuits

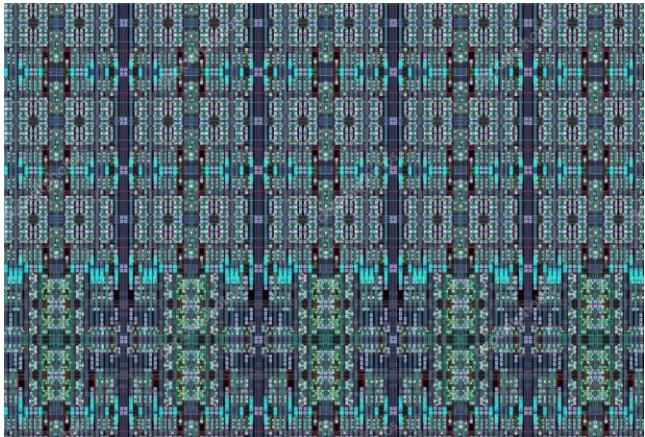
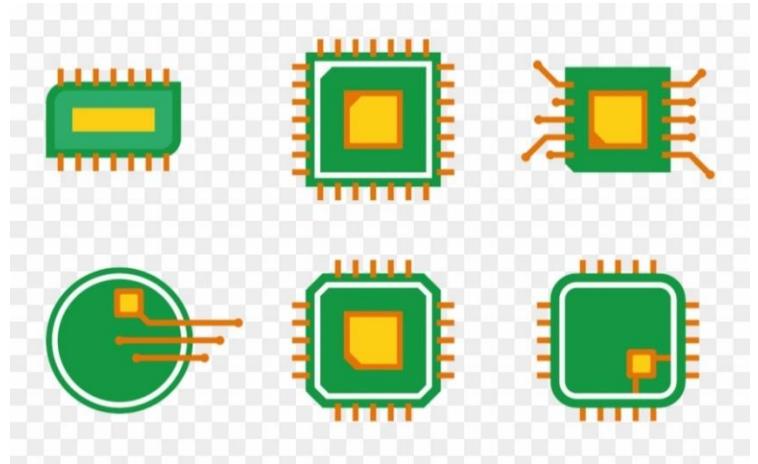
- Communication among the Devices
  - Internet
  - Internet of things

Algorithms, protocols, signal processing, modeling and simulations

# Introduction



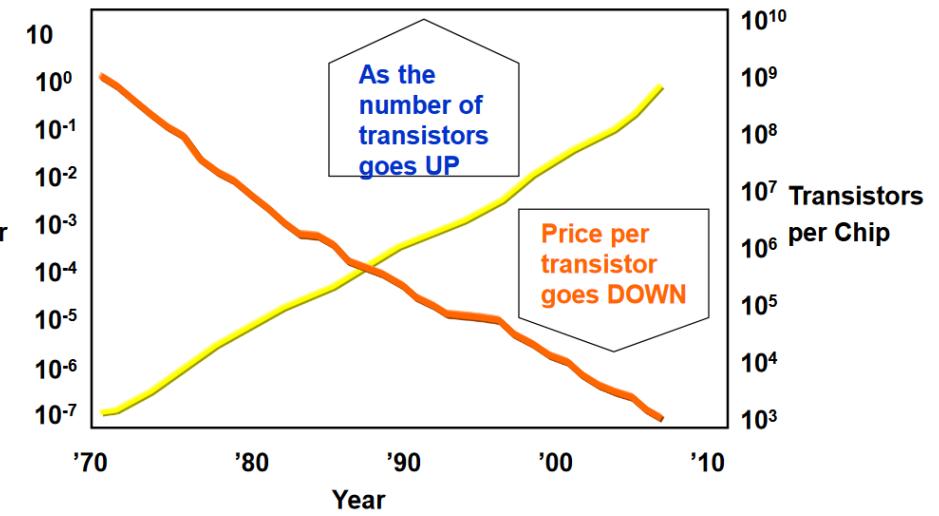
Integrated circuits



Layout of a chip

Game of  
electrons

\$ per  
Transistor



Moore's law and Scaling

Number of transistors would double every 18 months.

**The story of electronics is the story of conquest of the  
electron**

# Electronics and Communication Engineering



## Devices

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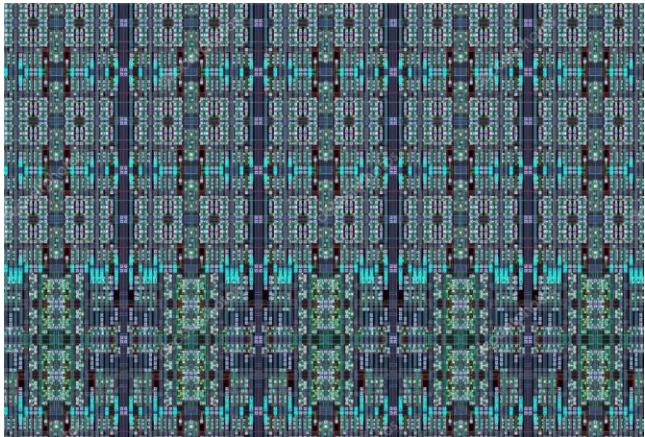
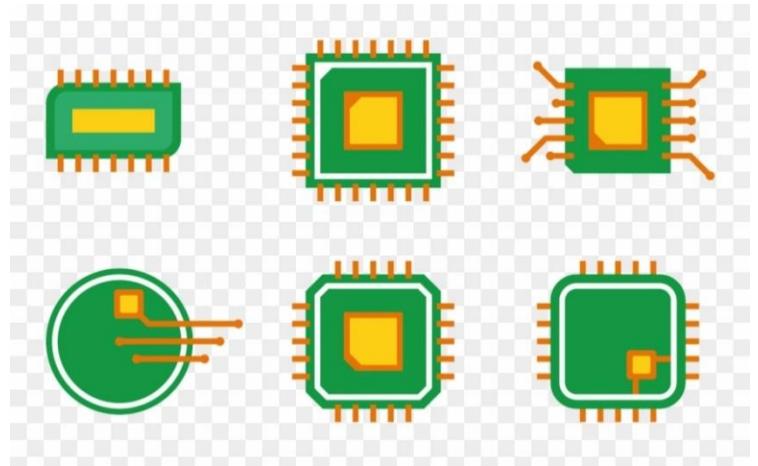
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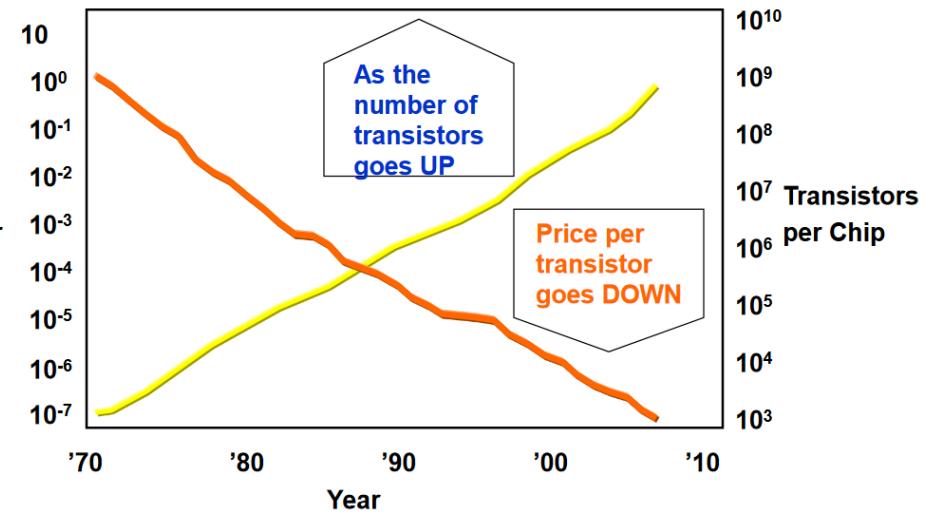
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# History

## Pre-electronics era

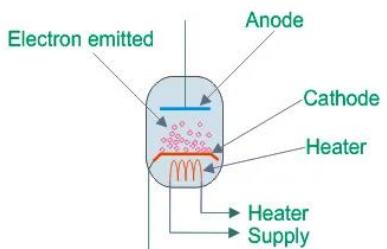
Pre-20<sup>th</sup> century,  
Almost no electronics in  
common man's life

Electricity, Magnetism  
and technologies based  
on that

## Vacuum tube electronics

Vacuum tube diode  
and triode invention,

Facilitated the  
invention of the first  
computer



## Transistor era

The  
semiconductor  
era

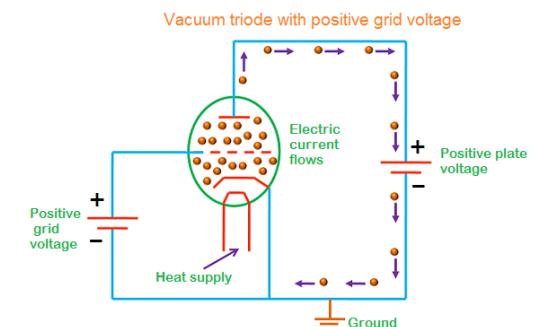
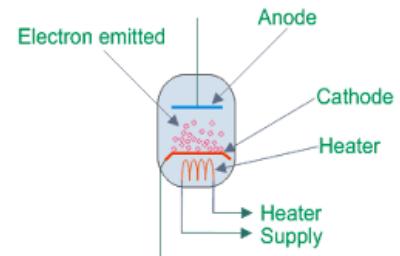
Start with the  
birth of solid state  
triode - transistor

# History – Summary

- Willian Gilbert, 16<sup>th</sup> Century
- Benjamin Franklin, 18<sup>th</sup> century
- Hans Christian Oersted
- Faraday
- Maxwell
  - Maxwell's equations for electromagnetic field.
  - Paved the way for the development of electric machines and communication systems.
- Edison
  - Electric bulb
  - DC
- Tesla
  - Induction motor
  - AC
- Alexandra Graham Bell, Elisha Gray
  - Telephone
- Henry Hertz
  - Radio waves (Method to transmit and detect)
- Indian Scientist J.C. Bose, Russian scientist Popov, Italian electrical engineer Marconi
  - Invented the radio and used antennas for radio communications.
- Electronic devices..
  - Vacum tube etc.

# Vacuum tube electronics era, 20<sup>th</sup> century

- The first decade saw the invention of vacuum tube
- John Ambrose Fleming (UK), 1904
  - He developed a device he called an "oscillation valve" (because it passes current only in one direction). The heated filament, was capable of thermionic emission of electrons that would flow to the plate (or anode) when it was at a positive voltage with respect to the heated cathode. Electrons, however, could not pass in the reverse direction because the plate was not heated and thus not capable of thermionic emission of electrons.
  - It worked as a very important part in radio communication – for AC to DC conversion
  - This is considered to be the birth of electronics.
- Lee De Forest (US), 1906
  - Invented triode
  - Besides anode and cathode, it had a third terminal as well (grid) which controls the flow of the electrons
  - It acted like amplifier – a key component in communication



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**Thank you**