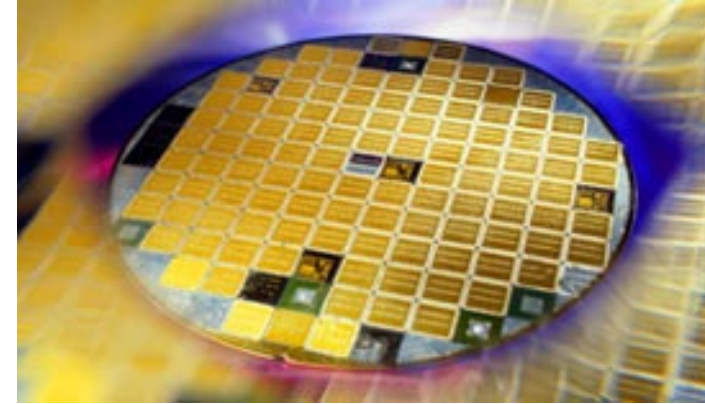
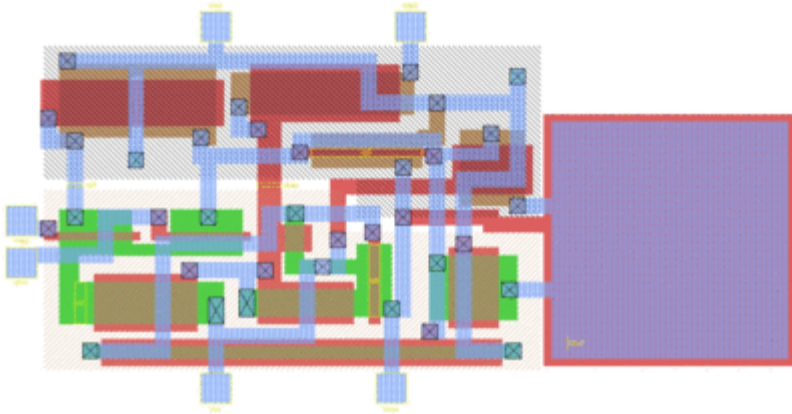


IC Design



- IC Design is the incorporation of techniques to design Analog or Digital IC comprising of resistors, capacitors, diodes and transistors.
- IC Design results in the consequent production of Masks required in the particular Wafer Fabrication process of Photolithography.
- IC Design is concerned with placement of components from the plan view.
- Wafer Fabrication engineers are concern with achieving components and device cross sectional structures.

IC Design Stages

Architecture & Microarchitecture



Specifications



Circuit Design &/or Register Transfer Level (RTL)



Physical Design



Tape out for Mask Generation

Architecture & Microarchitecture

- Architecture is the initial system level concept that defines the fundamental structures & purpose of the chip based on market opportunities and feasibility.
- Microarchitecture planning implements the architecture.
- The work product of architecture & microarchitecture is the specification.
- This upper level stage is very important as it defines how the chip will finally function & operate.
- Engineers will spend much time deliberating & discussing at this stage.

Specification

- Defines functional requirements.
- Simulation of functions can be done using software

Circuit Design &/or RTL

- Implements the functions in actual hardware level using hardware description language Verilog, SystemVerilog or VHDL.
- Its actually the hardware emulation stage for the chip:
 - ✓ functional verification.
 - ✓ functional simulation.
 - ✓ functional prediction.

Physical Design

This stage involves:

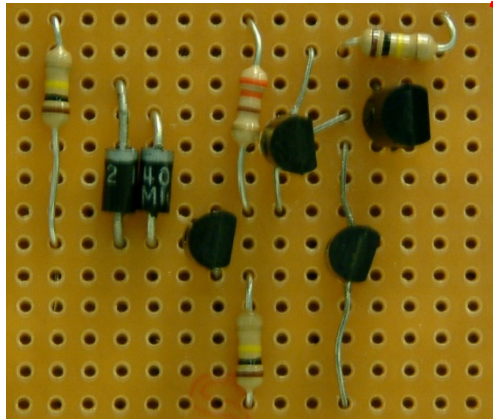
- Synthesis resulting in the RTL mapping into a Netlist.
- Floor planning & Placement.
- Routing & Connecting Lines

Tape out & Mask Generation

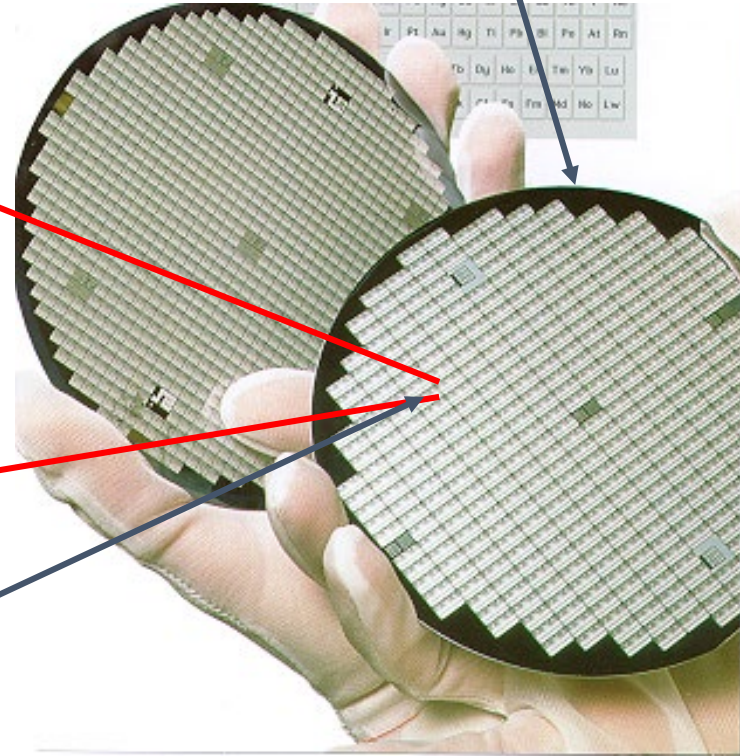
- Final & important stage for Wafer Fabrication of the IC design into actual physical chip.
- Design data is turned into photo masks to be used for the fabrication of the chip.
- Photo masks are required during photolithography so the pattern of the IC components placement & routing can be realized on the chip.

Integrated Circuit (IC)

Circuit to produced as IC



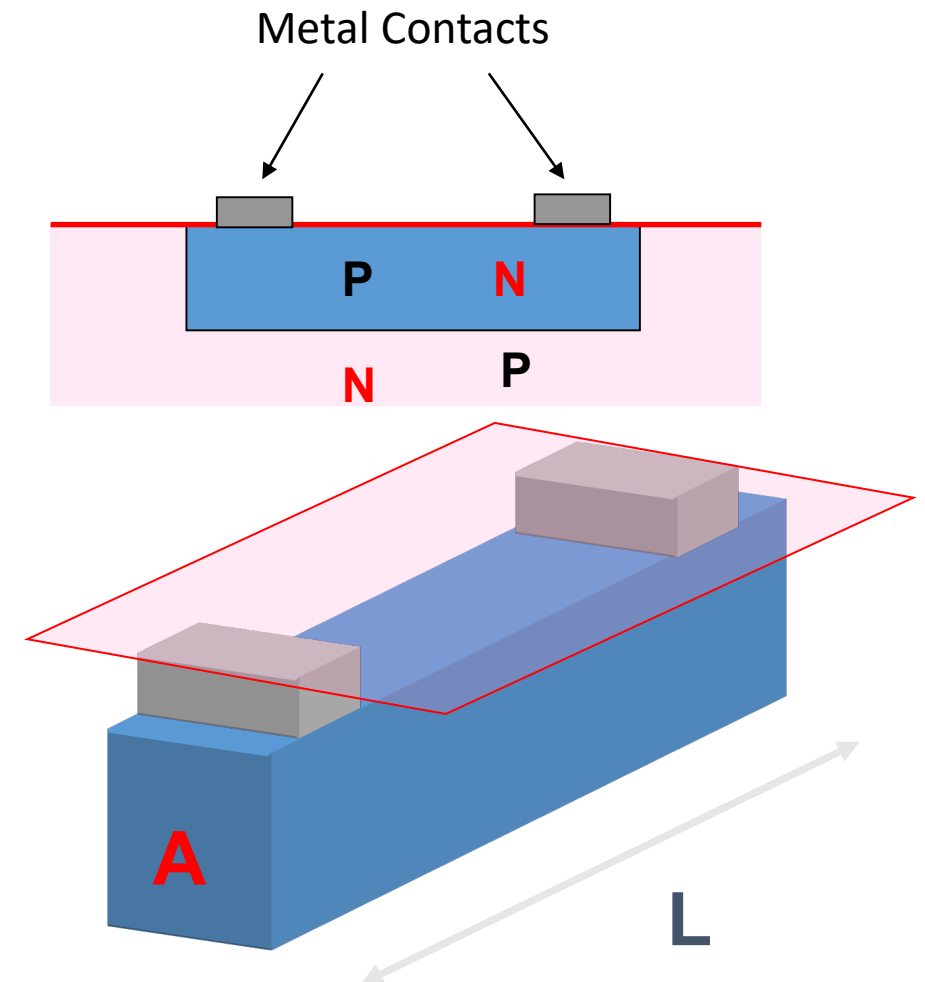
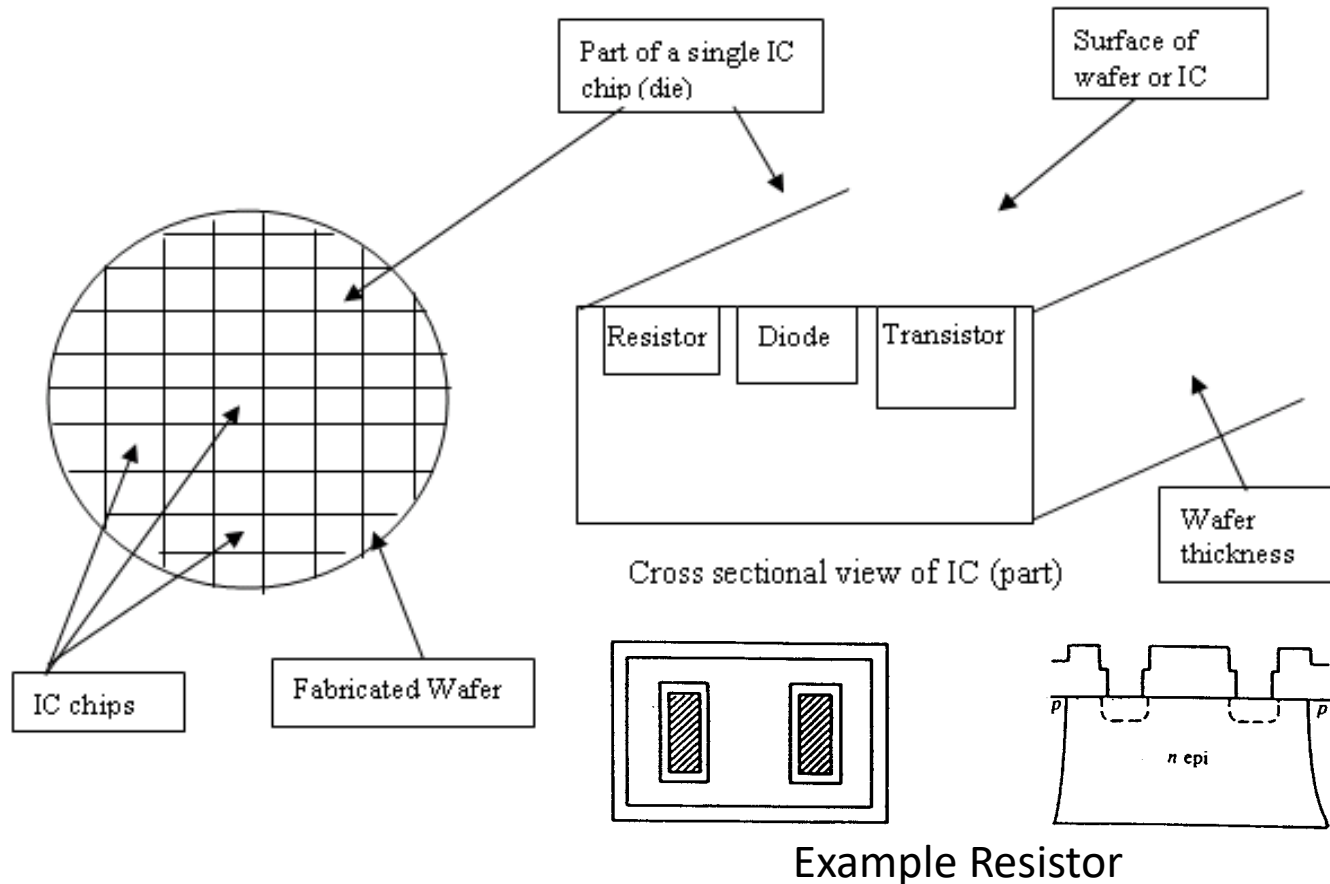
Silicon Wafer



IC chip produced

Integrated Circuit (IC)

- IC Design is concerned with placement of components from the plan view.
- Wafer Fabrication engineers are concern with achieving components and device cross sectional structures.



Classification of IC & Types of Components

- SSI (Small Scale Integration): 2 to 50 components
- MSI (Medium Scale Integration): 51 to 5000 components
- LSI (Large Scale Integration): 5001 to 100,000 components
- VLSI (Very Large Scale Integration): 100,001 to 1 million components
- ULSI (Ultra Large Scale Integration): More than 1 million components
- Component Types in IC:
 - ✓ Resistor
 - ✓ Capacitor
 - ✓ Diode
 - ✓ Transistor – BJT, MOS

Microelectromechanical Systems (MEMS)

- An exciting area of research & products.
- Combine the signal processing and computational capability of IC with non electrical elements like pressure or temperature sensors &/or mechanical gears actuators.

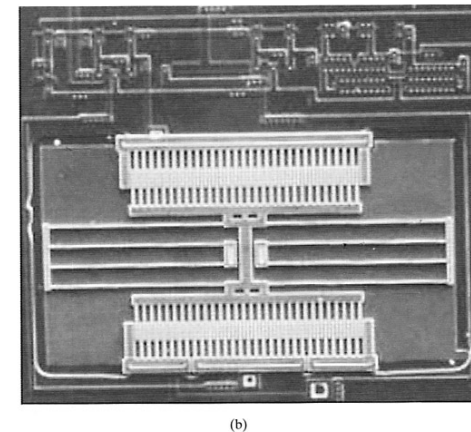
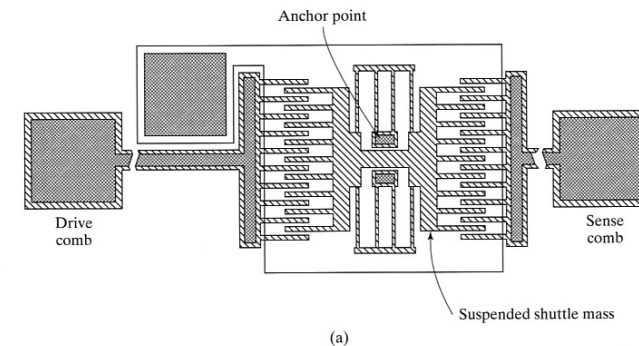
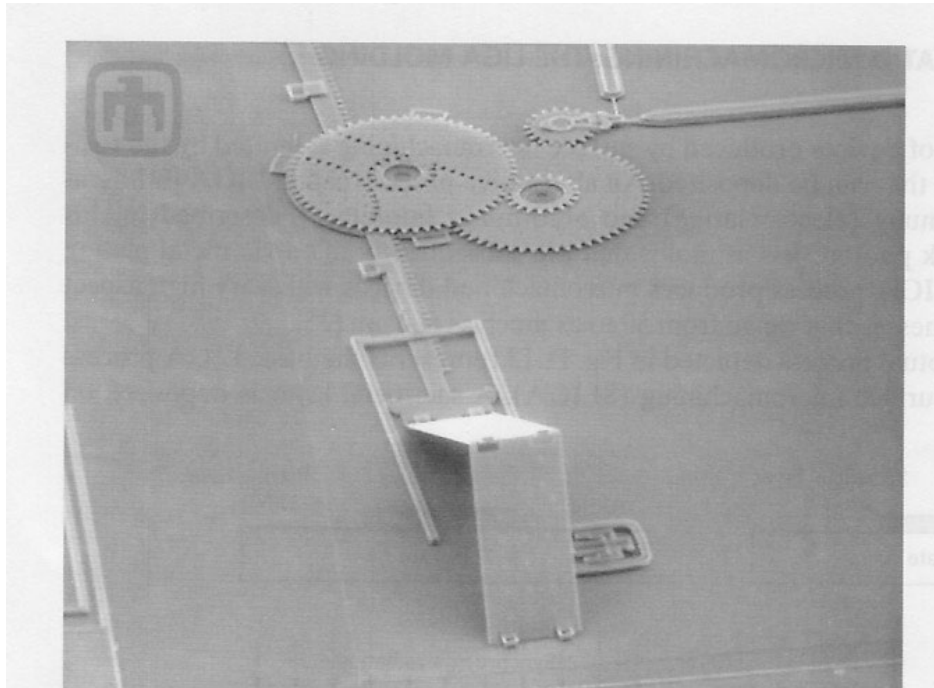
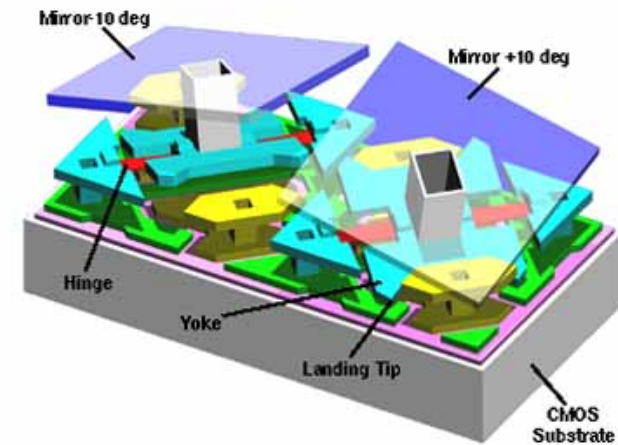
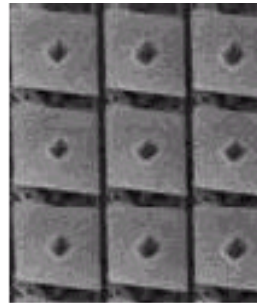


FIGURE 11.11

(a) Layout of a polycrystalline resonant beam structure with electrostatic comb drive. (b) Microphotograph of a fabricated structure. Copyright 1993, IEEE. Reprinted with permission from Ref. [21].

Microelectromechanical Systems (MEMS)

- Chemical sensors & Biosensors are also possible for the detection of hazardous chemical and biological systems, drug screening & DNA analysis.
- Micromirrors actuators used in Digital Light Processing (DLP) for example hand held pen or phone projectors.



Microelectromechanical Systems (MEMS)

Advantages:

- Miniaturization (energy and material efficiency in manufacturing)
- Faster
- Increased selectivity and sensitivity
- Cost/performance advantage
- Improved accuracy & reliability

(MEMS structure & its fabrication to be covered in Advanced Wafer Fabrication Technology)

Photonics (Optoelectronics)

- Electronic devices or systems that source, detect & control light including invisible forms of infrared, ultra violet (UV), gamma rays, X-rays & laser.
- Photoresistor, Photodiode & Phototransistor & Laser Diode
- Charge Couple Imaging Device
- LCD, LED & OLED Displays
- Optocoupler used in Optical Fiber Communications
- Integrated Optical Circuit (IOC) or Photonic Integrated Circuit (PIC)

