

KIRINYAGA UNIVERSITY

EEE 2312

LECTURE 1

Integrated Circuits

REFs

Introduction to Microelectronics to Nanoelectronics

Design and Technology

Manoj Kumar Majumder



LECTURE OUTLINE

- ✓ Introduction
- ✓ History of IC
- ✓ Advantages of ICs
- ✓ Limitations of IC

INTRODUCTION

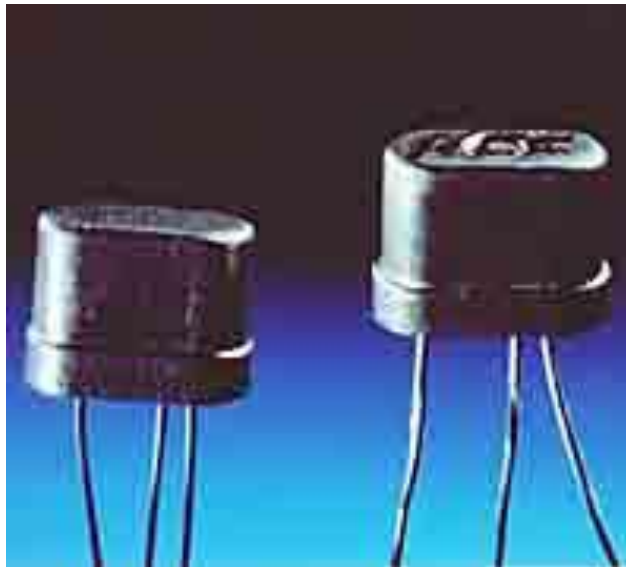
- ✓ The growth of electronics started with invention of vacuum tubes and associated electronic circuits.
- ✓ This activity termed as vacuum tube electronics, subsequently the evolution of solid state devices and consequent development of integrated circuits are responsible for the present status of communication, computing and instrumentation





WHAT IS AN INTEGRATED CIRCUIT (IC)?

It is a circuit where all discrete components such as passive as well as active elements are fabricated on a single crystal chip.





HISTORY OF IC

- ✓ The first semiconductor chip held two transistors each.
- ✓ The first integrated circuits held only a few devices, perhaps as many as ten diodes, transistors, resistors, and capacitors, making it possible to fabricate one or more logic gates on a single device.
- ✓ They were first developed in 1958 by Jack Kilby of Texas Instrument.
- ✓ Germanium was widely used as a semiconductor in some of the early discrete devices.
- ✓ Silicon has been the dominant semiconductor material used for integrated circuit fabrication and it may remain so since over 25% of the earth's crust is made of silicon a real silicon shortage is unlikely ICs can be designed from other materials, such as Gallium arsenide.



ADVANTAGES OF IC TECHNOLOGY

- ✓ Discrete circuits use individual resistors, capacitors, diodes, transistors, and other devices to achieve the circuit function.
- ✓ These individual or discrete parts must be interconnected. The usual approach is to use a circuit board.
- ✓ This method, however, increases the cost of the circuit as components, board, and assembly, soldering, and testing.
- ✓ ICs do not eliminate the need for circuit boards, assembly, soldering, and testing. However, the number of discrete parts can be reduced. This means that the circuit boards can be smaller, often use less power, and that they will cost less to produce.
- ✓ It may also be possible to reduce the overall size of the equipment by using integrated circuits, which can reduce costs in the chassis and cabinet.



- ✓ Integrated circuits may lead to circuits that require fewer alignment steps at the factory. This is especially true with digital devices.
- ✓ Alignment is expensive, and fewer steps mean lower costs. Also, variable components are more expensive than fixed components, and if some components can be eliminated, savings are realized finally, variable components are not as reliable as fixed components.
- ✓ Integrated circuits may also increase performance. Certain ICs work better than equivalent discrete circuits. Reliability is related indirectly to the number of parts in the equipment. As the number of parts goes up, the reliability comes down.
- ✓ Integrated circuits make it possible to reduce the number of discrete parts in a piece of equipment. Thus, electronic equipment can be made more reliable by the use of more ICs and fewer discrete components.



LIMITATIONS OF IC

IC components have certain limitations when compared with discrete components:

- ✓ Resistor accuracy is limited. However, resistors in hybrid ICs can be laser trimmed to overcome this.
- ✓ Very low and very high resistor values are not practical.
- ✓ Inductors are usually not practical.
- ✓ Only small values of capacitance are practical.
- ✓ PNP transistors tend to not perform as well as discrete types.



NEXT LECTURE

IC Classification