

Introduction to Electronics

Introduction to Electronics – Study Notes

1. What Is Electronics?

Aspect	Description
Definition	The branch of physics and engineering that deals with the flow of electrons (electric charge) through devices, circuits, and systems.
Goal	To control, manipulate, and use electrical energy for information processing, signal amplification, power conversion, and sensing.
Key Domains	Analog electronics, digital electronics, power electronics, signal processing, microelectronics.

2. Fundamental Concepts

Concept	Symbol / Unit	Key Points
Voltage (V)	V (volts)	Electrical “pressure” that drives charge. Measured between two points.
Current (I)	I (amperes, A)	Flow of charge per unit time. Direction defined by conventional current (positive to negative).
Resistance (R)	R (ohms, Ω)	Opposition to current flow. Ohm’s Law: $V = I \cdot R$.
Power (P)	P (watts, W)	Rate of energy transfer. $P = V \cdot I = I^2 \cdot R = V^2 / R$.
Capacitance (C)	C (farads, F)	Ability to store electric charge. Energy: $E = \frac{1}{2} C V^2$.
Inductance (L)	L (henries, H)	Ability to store magnetic energy. Energy: $E = \frac{1}{2} L I^2$.
Semiconductor	—	Material with conductivity between conductor and insulator; basis for diodes, transistors, ICs.

3. Basic Electronic Components

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Component	Symbol	Function	Typical Applications
Resistor	R	Limits current, creates voltage drops, sets bias points.	Pull?up/down, voltage dividers, filtering.
Capacitor	C	Stores charge, blocks DC, passes AC, smooths voltage.	Coupling/decoupling, timing circuits, power supplies.
Inductor	L	Stores magnetic energy, opposes changes in current.	Filters, transformers, RF tuning.
Diode	D	Allows current in one direction (forward bias) only.	Rectification, protection, signal clipping.
LED (Light Emitting Diode)	LED	Emits light when forward?biased.	Indicators, displays, lighting.
Transistor	Q	Current/voltage controlled switch or amplifier. • BJT (Bipolar) – NPN/PNP • MOSFET – enhancement/depletion	Switching power, amplification, logic gates.
Integrated Circuit (IC)	—	Multiple devices fabricated on a single chip.	Microcontrollers, op?amps, logic families.
Switch	—	Manually opens/closes a circuit.	User input, power control.
Potentiometer	—	Variable resistor.	Volume control, sensor calibration.

4. Simple Circuit Topologies

4.1 Series Circuit

- **Current** is the same through all elements.
- **Voltage** divides proportionally to resistance: ($V_i = I \cdot R_i$).
- Total resistance: ($R_{\text{total}} = R_1 + R_2 + \dots$)

4.2 Parallel Circuit

- **Voltage** across each branch is identical.
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