

Introduction to Electronics

Introduction to Electronics – Study Notes

1. What Is Electronics?

- **Definition:** The branch of physics and engineering that deals with the flow of electrons (electric charge) through various materials and devices.
 - **Scope:** Design, analysis, and application of circuits that control and manipulate electrical signals.
 - **Key Idea:** Unlike power engineering (which focuses on high-power, high-voltage systems), electronics works with low-power signals for information processing, sensing, and control.
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2. Fundamental Concepts

Concept	Symbol / Unit	Brief Explanation
Voltage (V)	(V) – volts	Electrical potential difference; “pressure” that pushes charge.
Current (I)	(I) – amperes (A)	Flow of charge per unit time.
Resistance (R)	(R) – ohms (Ω)	Opposition to current flow.
Power (P)	(P) – watts (W)	Rate of energy conversion, $(P = VI = I^2R = V^2/R)$.
Capacitance (C)	(C) – farads (F)	Ability to store charge; $(Q = CV)$.
Inductance (L)	(L) – henries (H)	Ability to store magnetic energy; $(V = L \frac{dI}{dt})$.
Semiconductor –		Material whose conductivity lies between conductors and insulators; basis for diodes, transistors, ICs.

3. Basic Electronic Components

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Component	Symbol	Function	Typical Use
Resistor	(R)	Limits current, creates voltage drops	Biasing, voltage dividers
Capacitor	(C)	Stores energy, filters, couples AC	Decoupling, timing circuits
Inductor	(L)	Stores magnetic energy, opposes current change	Filters, transformers
Diode	(D)	Allows current in one direction	Rectification, protection
Transistor (BJT)	(Q)	Current/voltage controlled switch or amplifier	Amplifiers, switches
MOSFET	(M)	Voltage controlled switch	Power switching, digital logic
Integrated Circuit (IC)	–	Multiple components in one package	Microcontrollers, op?amps, logic gates
Switch	–	Manually opens/closes a circuit	User input, power control
LED	–	Light?emitting diode	Indicators, displays

4. Simple Circuit Building Blocks

4.1 Voltage Divider

$$[V_{out} = V_{in} \frac{R_2}{R_1 + R_2}]$$

- Provides a reduced voltage from a higher source.
- Used for biasing, reference voltages, sensor scaling.

4.2 RC Low?Pass Filter

- **Cut?off frequency:** $(f_c = \frac{1}{2\pi RC})$
- Passes low frequencies, attenuates high frequencies.
- Applications: audio smoothing, debouncing, anti?aliasing.

4.3 RL High?Pass Filter

- **Cut?off frequency:** $(f_c = \frac{R}{2\pi L})$
- Passes high frequencies, blocks low frequencies.
- Used in coupling stages and RF circuits.