SNS COLLEGE OF TECHNOLOGY

Saravanampatti, Coimbatore – 641 035

Approved by AICTE, Recognized by UGC & Affiliated to Anna University, Chennai

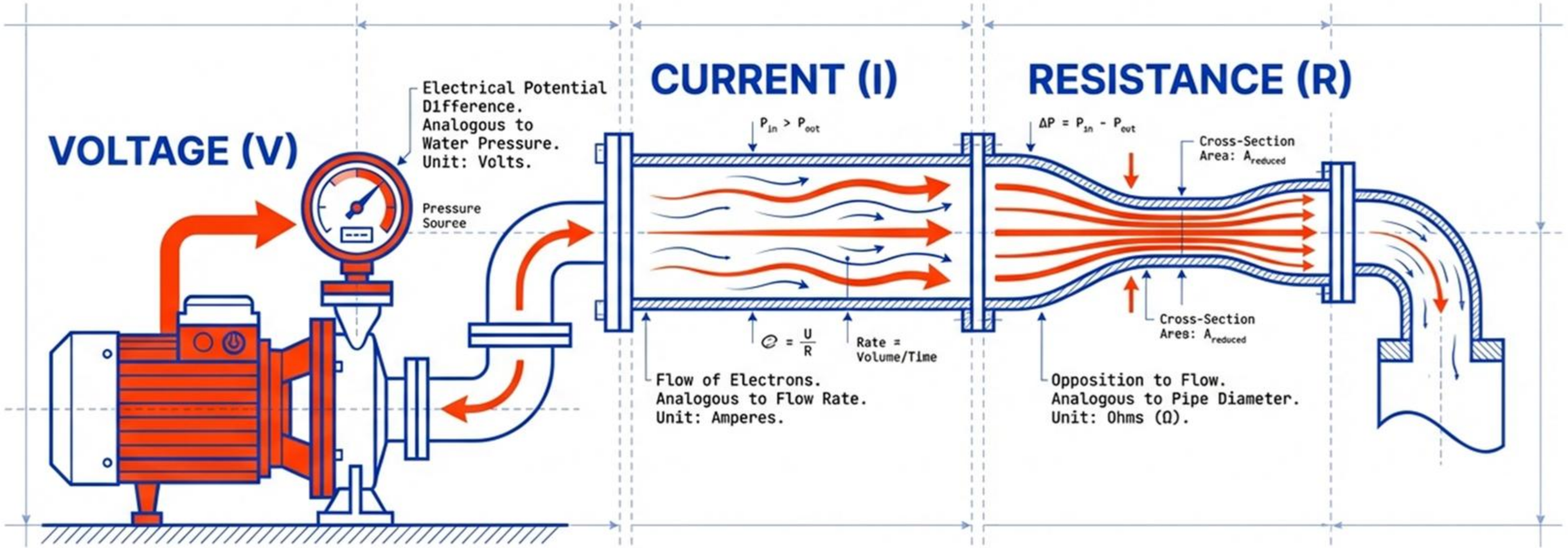
Department of Electronics and Communication Engineering

23EET103 – Electric Circuits and Electron Devices

I YEAR /II SEMESTER

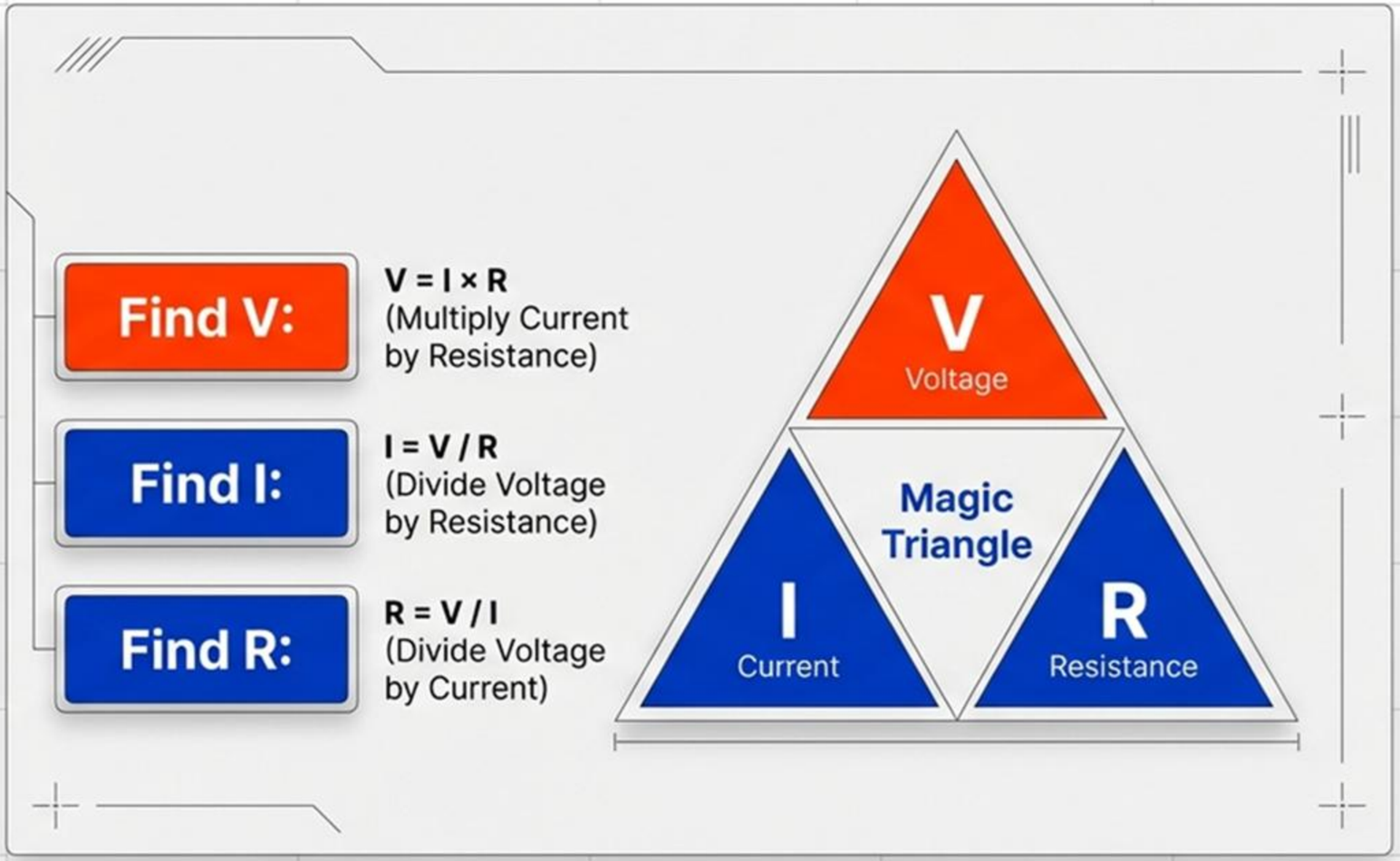
UNIT -1 – Ohm’s Law

The Hydraulic Analogy: A System of Flow



The Linear Model: V = I × R

The law states that current through a conductor is directly proportional to the voltage across it.



Engineering Utility: Why the Math Matters

Protection

Preventing Failure
Calculating necessary resistance to stop components (like LEDs) from blowing up.

Energy

Power Requirements.
Determining how much juice a device draws from a supply.

Diagnostics

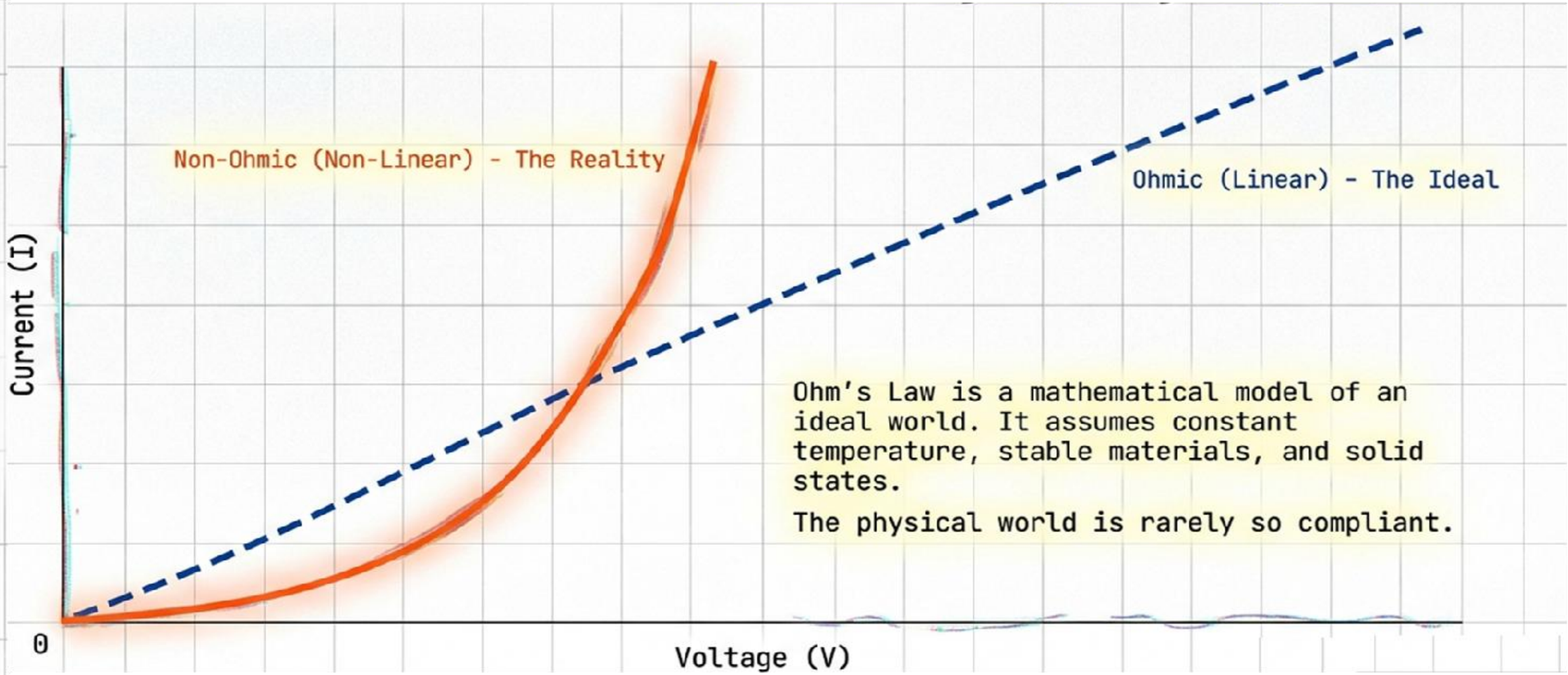
Troubleshooting.
Measuring resistance or voltage to locate the "clog" in a broken circuit.

Application: The Current Limiter

The Problem:
An LED connected directly to a power source will draw infinite current until it fails.

The Solution:
We use Ohm's Law to calculate the specific Resistor needed to throttle the flow.

When the Law Breaks: The Reality of Physics



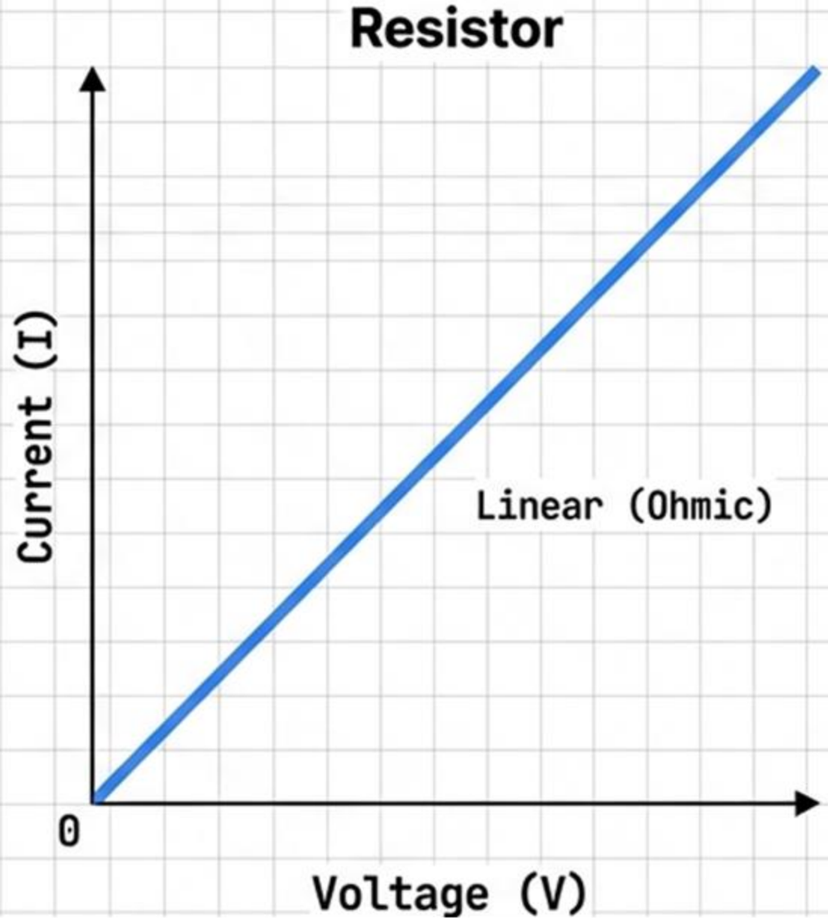
Constraint 01: Thermodynamics & Heat

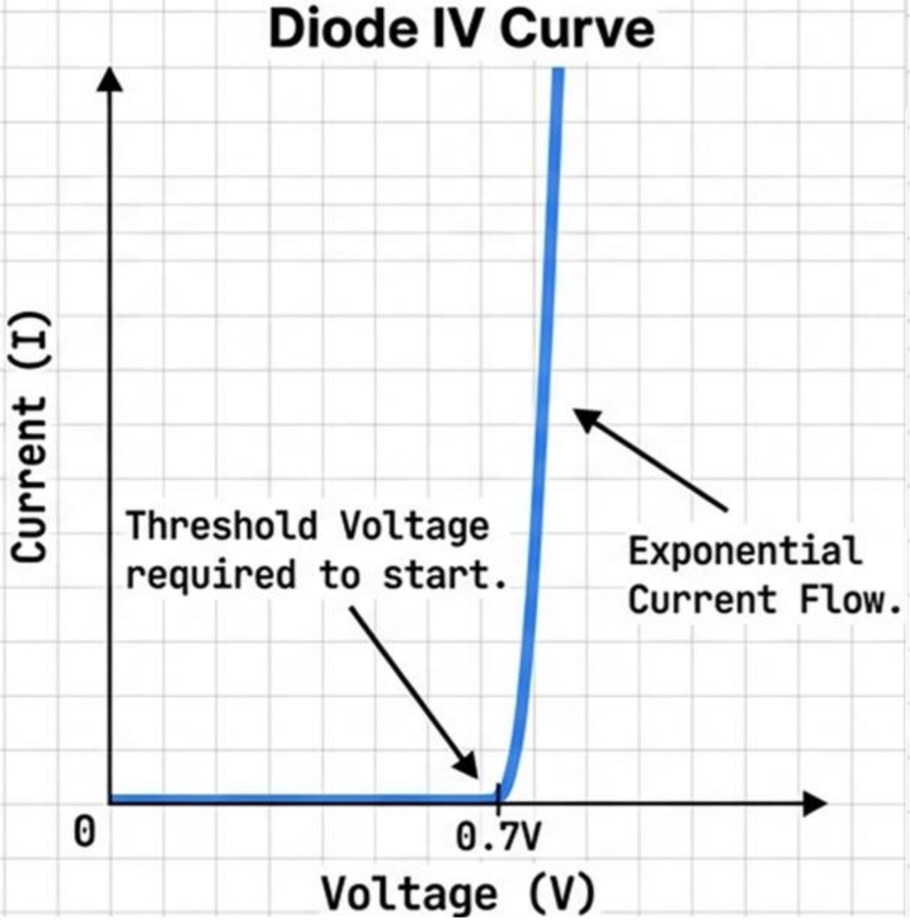
The Rule:
Ohm's Law assumes temperature remains constant.

The Reality:
Current generates heat. In most metals, increased heat = increased resistance.

Temperature Increase

Constraint 02: Non-Ohmic Semiconductors





Diodes & LEDs are directional. Current only flows one way and requires a push to start.

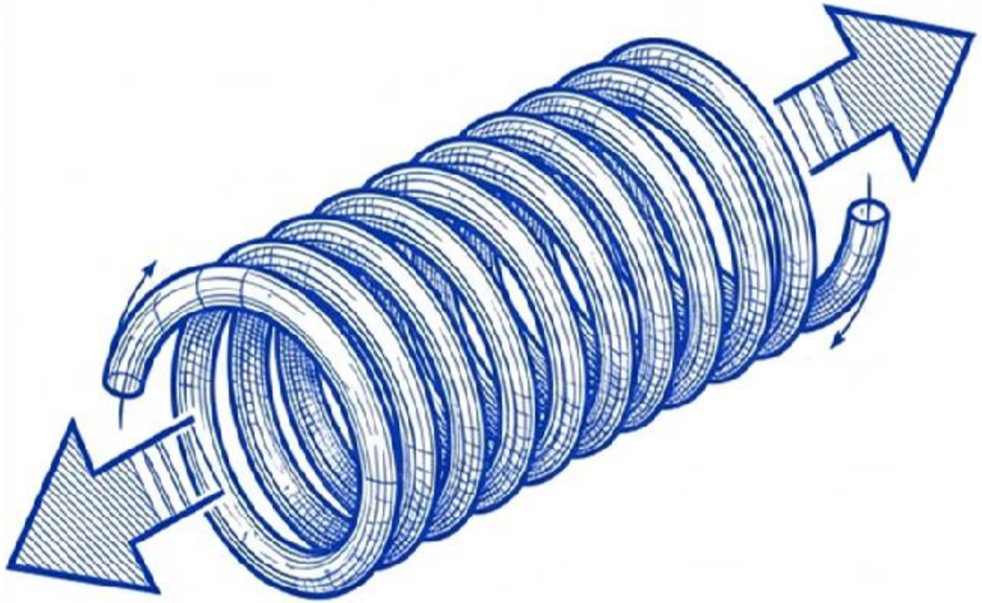
Transistors act as active switches.

Result: Resistance is not fixed; it changes based on voltage.

Constraint 03: Material State & Stability

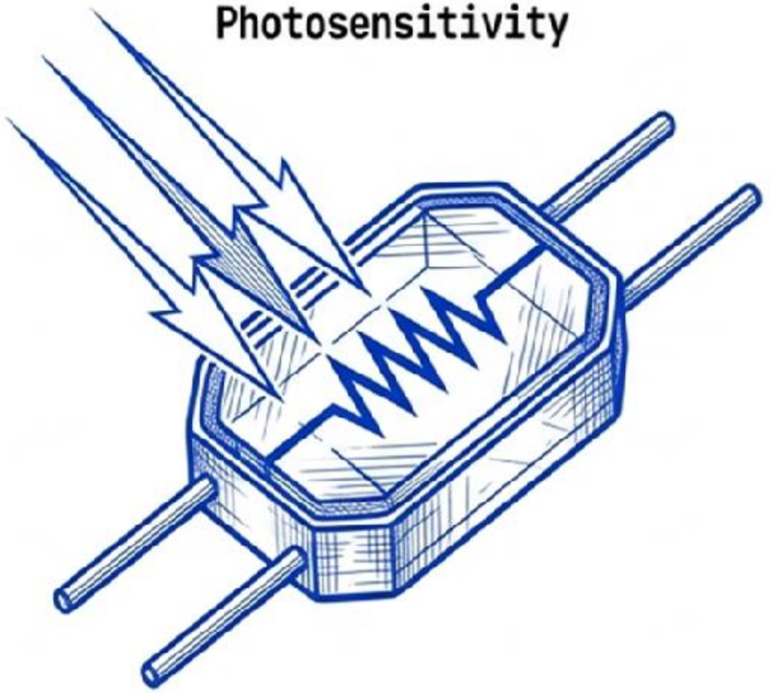
If the physical state of the conductor is not stable, the formula fails.

Mechanical Stress



Stretching or compressing a conductor alters its physical structure and changes its resistance.

Photosensitivity



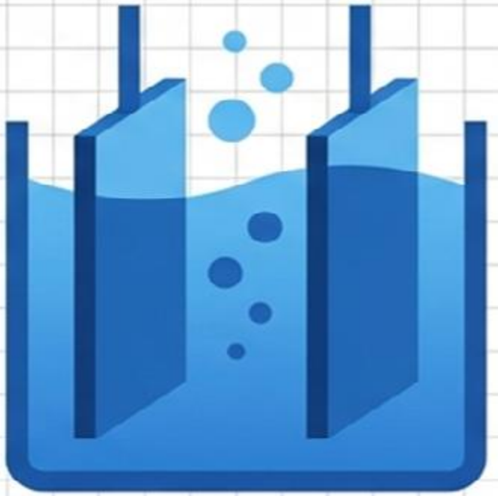
Components like Light Dependent Resistors change resistance based on ambient brightness, completely independent of voltage.

Constraint 04: Gases & Electrolytes

Gases (Neon/Lightning)

Highly non-linear. Gases act as insulators until a massive ‘breakdown voltage’ is reached, causing resistance to drop sharply.

Electrolytes (Batteries/Acids)



Chemical Complexity. Reactions at electrodes create ‘back-pressure’ (back-EMF) that interferes with standard calculations.

Synthesis: The Deviation Matrix

FACTOR	EFFECT	RESULT
Temperature Rise	Increases resistance in metals	Formula becomes inaccurate
Semiconductors	Conducts non-linearly	V/I ratio is not constant
Vacuum Tubes	Electron emission dependencies	Current depends on emission, not just voltage
Gas Discharge	Ionization breakdown	Resistance drops sharply after breakdown

REFERENCES

- https://www.electrical4u.com
- https://www.allaboutcircuits.com
- https://nptel.ac.in/courses/108106172

THANK YOU