

Introduction to Electrical Engineering

Introduction to Electrical Engineering Technology

Key concepts, tools, and career pathways

1. What Is Electrical Engineering Technology (EET)?

Aspect	Description
Focus	Application of electrical engineering principles to design, test, install, and maintain electrical/electronic systems.
Difference from Electrical Engineering	• EE: heavy emphasis on theory, mathematical modeling, and research. • EET: hands-on implementation, troubleshooting, and practical solutions.
Typical Work Environments	Manufacturing plants, power utilities, telecommunications, aerospace, automotive, consumer electronics, and R&D labs.
Core Goal	Translate engineering concepts into functional, reliable hardware and systems.

2. Fundamental Topics

2.1 Circuit Theory

- **Ohm's Law** – $V = I \cdot R$
- **Kirchhoff's Laws** – Current (KCL) & Voltage (KVL) rules.
- **Series & Parallel Networks** – Compute equivalent resistance, voltage division, current division.
- **Thevenin & Norton Equivalents** – Simplify complex networks for analysis.

2.2 AC Power Fundamentals

- **Sinusoidal Waveforms** – RMS, peak, and average values.
- **Phasor Representation** – Complex numbers to handle magnitude & phase.
- **Power Types** – Real (P), Reactive (Q), Apparent (S); Power factor (PF = P/S).
- **Three-Phase Systems** – Star (Y) and Delta (Δ) connections, line vs. phase quantities.

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2.3 Digital Logic & Microcontrollers

Technology

- **Binary Number System** – Base-2 arithmetic, Boolean algebra.
- **Logic Gates** – AND, OR, NOT, NAND, NOR, XOR, XNOR.
- **Combinational & Sequential Circuits** – Multiplexers, decoders, flip-flops, counters.
- **Microcontroller Basics** – Architecture (CPU, memory, I/O), programming (C/Assembly), peripheral interfacing.

2.4 Electronics

- **Semiconductor Devices** – Diodes, transistors (BJTs, MOSFETs), optoelectronics.
- **Amplifier Configurations** – Common-emitter, common-source, differential.
- **Analog Signal Processing** – Filters (low-pass, high-pass, band-pass), oscillators, regulators.
- **Printed Circuit Board (PCB) Design** – Schematic capture, layout rules, fabrication steps.

2.5 Power Systems

- **Generation** – Turbines, generators, renewable sources (solar, wind).
- **Transmission & Distribution** – High-voltage lines, transformers, substations.
- **Protection Devices** – Circuit breakers, fuses, relays, protective coordination.
- **Smart Grid Concepts** – Sensors, SCADA, demand response, renewable integration.

2.6 Instrumentation & Measurement

- **Multimeters, Oscilloscopes, Spectrum Analyzers** – Basic usage and safety.
- **Signal Conditioning** – Amplification, filtering, isolation.
- **Data Acquisition (DAQ)** – Analog-to-digital conversion, sampling theory (Nyquist).
- **Calibration & Uncertainty** – Traceability, error analysis.

3. Laboratory & Hands-On Skills

Skill	Typical Lab Activity
Soldering	Assemble simple kits, repair PCB traces.
Breadboarding	Prototype circuits, test logic functions