15-DAY TRAINING PROGRAM FOR ELECTRONIC DEPARTMENT STUDENTS

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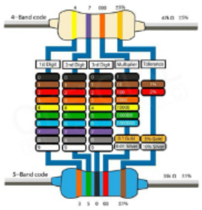
WEEK 1:Fundamentals and Basic Circuits

DAY 1: INTRODUCTION TO ELECTRONICS & COMPONENTS

1.**Basics of resistors :** A resistor is an electronic component that resists the flow of electric current. It's used to control voltage and current in a circuit.

Key concepts: Resistance , Ohms law, Types of resistors (fixed,variable and special

types), color code and power rating (measured in watts).



2. Capacitors: A capacitor is a passive electronic component that stores and releases electrical energy. It does this by accumulating charge on two conductive plates separated by an insulating material called a dielectric.

Key concepts: Capacitance , voltage rating and dielectric.

DAY 2: CIRCUIT LAWS(OHM'S & KIRCHHOFF'S LAW'S)

Circut analysis techniques

Circuit analysis techniques are methods used to determine the voltages, currents, and power in electrical circuits. Here are the main ones:

1.Ohms law : $V = I \times R$ Basic relationship between voltage (V), current (I), and resistance (R).

2. Kirchhoff law: Kirchhoff's Current Law (KCL): The sum of currents entering a node = sum of currents leaving the node. Kirchhoff's Voltage Law (KVL): The sum of voltages around any closed loop = 0.

DAY 3:SEMICONDUCTOR BASICS

A semiconductor is a material that has electrical conductivity between that of a conductor (like copper) and an insulator (like glass). It can conduct electricity under certain conditions, which makes it essential in electronic devices.

Common Semiconductor Materials:

- Silicon (Si) – the most widely used.
- Germanium (Ge)
- Gallium arsenide (GaAs) – used in high-speed devices.

Doping:

The process of adding impurities to a semiconductor to increase its conductivity:

- N-type (Negative): Extra electrons are added (e.g., using phosphorus in silicon).
- P-type (Positive): Creates "holes" (missing electrons), making it easier for current to flow (e.g., using boron in silicon).

Applications:

Semiconductors are used in:

- Computers
- Smartphones
- Solar cells
- LEDs
- Integrated circuits (ICs)
- Power electronics

DAY 4:DIGITAL ELECTRONIC'S(LOGIC GATES)

Digital electronics deals with circuits that operate using digital signals—signals that have only two states:

- ON (1 or HIGH)
- OFF (0 or LOW)

This binary system forms the foundation of computers and most modern electronic devices.

Key Components:

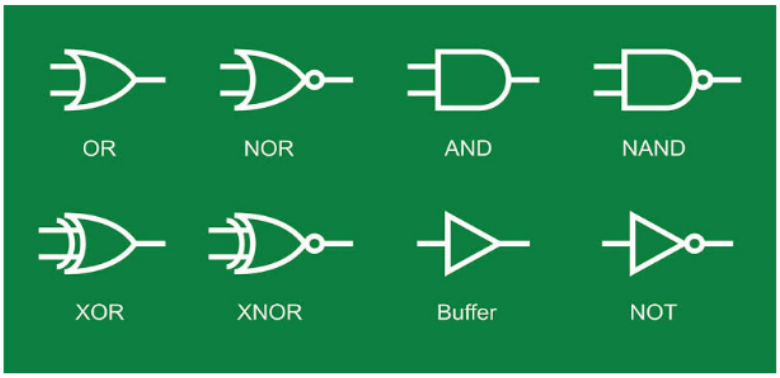
- Logic Gates – Perform basic operations (AND, OR, NOT, NAND, NOR, XOR, XNOR).
- Flip-Flops – Store 1-bit of data; used in memory and registers.
- Multiplexers/Demultiplexers – Route data between sources and destinations.
- Counters – Count pulses, often used in timers or frequency dividers.
- Registers – Store multiple bits of data.
- Microcontrollers / Microprocessors – Small computers or processing units.

Binary Numbers:

Digital systems use the binary number system (base-2). Every number is represented using only 0s and 1s.

Combinational vs Sequential Logic:

- Combinational Logic: Output depends only on current inputs (e.g., logic gates).
- Sequential Logic: Output depends on current input and previous states (e.g., flip-flops, counters).



DAY 5: SOLDERING AND PCB BASICS

Soldering is the process of joining electronic components to a PCB using a metal alloy (solder) that melts at a low temperature.It creates both a mechanical and electrical connection.

Basic Tools:

- Soldering iron
- Solder wire (usually a mix of tin and lead or lead-free)
- Flux (cleans surfaces for better bonding)
- Solder sucker or wick (for removing solder)
- Tweezers & cutters

A **Printed Circuit Board (PCB)** holds and connects electronic components using copper traces instead of wires.

Layers:

- Single-layer: One copper side (simple circuits)
- Double-layer: Copper on both sides
- Multi-layer: Complex circuits like in computers or phones

Basic Soldering Steps:

1. Heat the pad and component lead with the soldering iron.
2. Apply solder to the joint (not the iron tip).
3. Remove the solder, then the iron.
4. Let it cool naturally.

Good Solder Joint: Shiny, cone-shaped, no bridges or cold joints.

Common Mistakes to Avoid:

- Cold solder joints (dull, weak)
- Solder bridges (unwanted connections)
- Overheating components
- Not using flux (leads to poor connections)

Surface Mount vs Through-Hole:

- Through-Hole: Component leads go through PCB holes (better for prototyping).
- Surface Mount (SMD): Components sit directly on PCB pads (used in modern, compact devices).

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WEEK 2: Embedded Systems & Microcontrollers

DAY 6:ARDUINO/RASPBERRY PI INTRO

Arduino is an open-source electronics platform designed for easy use by beginners and hobbyists.

- Main components: a microcontroller board (e.g., Arduino Uno) + Arduino IDE software.
- Programming: uses a simplified version of C/C++.
- What it does: controls hardware like LEDs, motors, sensors, and more.
- Typical uses: building alarms, robots, smart lights, or any project that interacts with the physical world.
- Strength: excellent for real-time hardware control.

Raspberry Pi is a full mini-computer that runs a Linux-based operating system (usually Raspberry Pi OS).

- Main components: a small board with CPU, RAM, USB ports, HDMI, etc.
- Programming: supports many languages (Python is most common).
- What it does: can run apps, access the internet, connect to displays, and control hardware through GPIO pins.
- Typical uses: media centers, web servers, retro gaming, home automation, camera systems.
- Strength: powerful and versatile — behaves like a real PC.

```
int sensorPin = A0;
float temperature;

void setup() {
  Serial.begin(9600);
}

void loop() {
  int reading = analogRead(sensorPin);
  temperature = (reading * 5.0 * 100.0) /
  Serial.println(temperature);
  delay(1000);
}
```

DAY 8: MOTOR CONTROL

Motor Control in Engineering (Electrical / Industrial Automation)

Purpose: To safely and efficiently operate electric motors in various applications, from household appliances to large industrial machines.

Main Components: Contactors: Electrically controlled switches used for switching motors on and off. Overload Relays: Protect motors from overheating by breaking the circuit if too much current is drawn. VFDs (Variable Frequency Drives): Control motor speed by varying the frequency and voltage supplied to the motor. Soft Starters: Gradually ramp up the motor speed to reduce mechanical stress and electrical inrush current. PLCs (Programmable Logic Controllers): Digital computers used for automation of electromechanical processes.

Motor Control in Neuroscience / Human Physiology

Definition: The process by which the nervous system coordinates muscle activity to produce movement.

Key Components:

- Central Nervous System (CNS): Brain and spinal cord, where motor planning and control occur.
- Motor Neurons: Carry signals from the CNS to muscles.
- Muscles: Respond to signals by contracting or relaxing.

Types of Motor Control:

- Gross Motor Skills: Large movements (e.g., walking, jumping).
- Fine Motor Skills: Precise movements (e.g., writing, buttoning a shirt).
- Voluntary Movements: Conscious control (e.g., reaching for a glass).
- Involuntary Movements: Reflexes or automatic responses (e.g., blinking).

DAY 9:WIRELESS COMMUNICATION

The ***Wireless communication*** is the transfer of data between devices without physical connections, using electromagnetic waves like radio or infrared.

Types of Wireless Communication:

1. Radio Communication: Used in FM/AM radios, walkie-talkies, and police radios.
2. Microwave Communication: Point-to-point communication, often used in satellite and cellular systems.
3. Infrared Communication: Used in TV remotes and short-range communication.
4. Bluetooth: Short-range communication between devices (like headphones, phones, etc.).
5. Wi-Fi: Provides wireless internet access.
6. Cellular Networks (3G/4G/5G): Used for mobile communication and internet access.
7. Satellite Communication: Long-distance communication using orbiting satellites.

Key Components:

- Transmitter: Converts data into signals.
- Receiver: Captures and converts signals back into data.
- Antenna: Sends/receives electromagnetic waves.
- Medium: Usually the air (vacuum or atmosphere).

DAY 10: MINI PROJECT

1. Obstacle-Avoidance Robot

The goal: Build a robot that moves by itself and avoids obstacles in its path.

Basic Components:

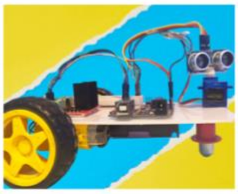
- Microcontroller
- Ultrasonic distance sensors
- DC motors + Motor driver
- Wheels, chassis, battery
- Jumper wires, breadboard

How It Works:

- The robot uses ultrasonic sensors to measure distance to nearby objects.
- If an obstacle is detected (e.g., less than 15 cm away), the robot stops and turns.
- If the path is clear, it keeps moving forward.

Team Task Division:

- One person programs the microcontroller.
- Another builds the circuit and handles wiring.
- Another designs/assembles the physical frame.
- Another tests and adjusts the behavior.



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Week 3: Advanced Topics & Industry Exposure

DAY 11:POWER ELECTRONICS

Power electronics is the field of electrical engineering that deals with the conversion, control, and conditioning of electric power using electronic devices. It's essential for efficiently managing and directing energy in everything from consumer electronics to industrial systems and renewable energy sources.

Key Areas in Power Electronics: Power Conversion: AC to DC (Rectifiers) DC to AC (Inverters) DC to DC (Converters – buck, boost, buck-boost) AC to AC (Cycloconverters, matrix converters)

Main Components: Semiconductor devices: Diodes, thyristors, MOSFETs, IGBTs

Passive components: Capacitors, inductors, transformers

Applications: Electric vehicles (EVs) Renewable energy systems (solar inverters, wind turbines) Motor drives and control Power supplies for electronics Smart grids and energy storage systems

Demonstration:

DC-DC Buck Converter (Step-Down Converter) Demonstration

Objective: Show how power electronics can reduce a higher DC voltage to a lower DC voltage efficiently.

Components Needed

(for a simple hardware demo):

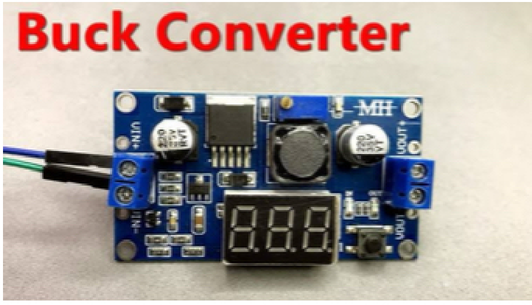
- 12V DC Power Supply (could be from an adapter or battery)
- Buck Converter Module (e.g., LM2596 module – cheap and widely available)
- Multimeter
- Small load (e.g., 12V LED or resistor)

Steps:

1. Input Power: Connect the 12V power source to the input of the buck converter module.
2. Set Output: Use the potentiometer on the module to adjust the output voltage.
3. Measure: Use the multimeter to measure input and output voltages.
4. Load Test: Connect an LED rated for 5V to the output, and observe it lighting up properly.

What This Demonstrates:

- Voltage conversion using power electronics.
- Efficiency: Less heat compared to using resistors or linear regulators.
- Practical use: Used in phone chargers, power supplies, EVs, etc.



DAY 12:IOT & INDUSTRY 4.0

Using ThingSpeak

Goal: Send temperature data from a DHT22 on an ESP32 to ThingSpeak.

1. Create a new ThingSpeak channel with two fields: "Temperature" and "Humidity."
2. Flash your ESP32 with the example code provided earlier (adjusting SSID, API key, channel ID).
3. Verify that new data points appear every 15 s on your ThingSpeak dashboard.

Multi-Sensor Logging to ThingSpeak

Goal: Log three different sensors (e.g., temperature, humidity, light) in one channel.

1. Wire a photoresistor (LDR) as a voltage divider, read it on an analog pin.
2. Modify your code to call ThingSpeak.setField(3, lightValue); as well as the DHT readings.
3. Ensure all three series appear on the same chart.

Threshold Alerts with ThingHTTP & React

Goal: When temperature exceeds a set point, send yourself an email or Slack notification.

1. In ThingSpeak Apps → ThingHTTP, create a new request that POSTS to an email-to-Slack webhook (or SMTP).
2. In React, set up a rule: "if field 1 > 30 °C, trigger ThingHTTP."
3. Test by placing your DHT22 near a heat source (e.g., a warm lamp).

Exercise:Build & Troubleshoot a Blinking LED Circuit on a PCB

Objective:

- Solder components onto a custom PCB.
- Power the circuit and verify correct functionality.
- Diagnose and fix common PCB faults.

What You'll Need:

Components:

- 1 × 555 Timer IC
- 1 × 8-pin IC socket (optional but recommended)
- 1 × 10µF capacitor (C1)
- 1 × 100nF capacitor (C2)
- 2 × 1kΩ resistors (R1, R2)
- 1 × LED
- 1 × 330Ω resistor (R3)
- 1 × 9V battery + clip or USB power source
- 1 × PCB

Tools:

- Soldering iron + solder
- Wire cutters
- Multimeter
- Flux pen/paste (optional)

Steps:

1. Schematic Understanding

Use the following configuration:

- Pin 1: GND
- Pin 2: Connect to Pin 6
- Pin 3: Output → 330Ω → LED → GND
- Pin 4: VCC
- Pin 5: Optional cap to GND (100nF)
- Pin 6: Connect to Pin 2
- Pin 7: Connect to R1 → VCC and R2 → Pin 6
- Pin 8: VCC

2. Soldering Practice

- Insert the IC socket and resistors first (low-profile components).
- Solder capacitors and LED.
- Carefully insert the 555 timer into the socket.
- Solder the power pins (and test with a multimeter for shorts).

3. Power the Circuit

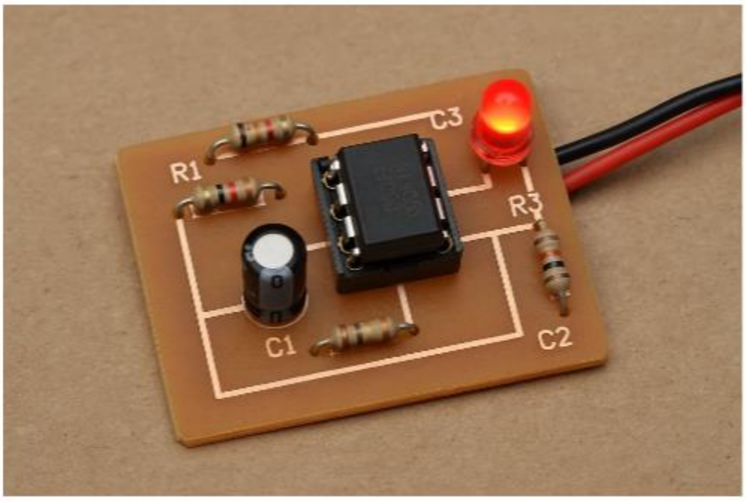
- Apply 9V (or USB 5V depending on design).
- The LED should blink at about 1 Hz.

4. Troubleshooting

If the LED doesn't blink:

- Check orientation of LED and 555 timer.
- Use a multimeter to:
  - Measure voltage at pin 8 (should be ~9V).
  - Check pin 3 for pulses (use LED or oscilloscope if available).
  - Look for cold joints or shorts between adjacent pins.
- Reheat and apply more solder/flux if needed.

The result:



DAY 14: GUEST LECTURE

Day 14 includes a special guest lecture featuring an industry expert who will share valuable insights into current career trends, emerging job opportunities, and the skills most in demand across various sectors. Participants will gain a deeper understanding of how the job market is evolving, what employers are looking for, and how to best position themselves for future success. This session also provides a unique opportunity for attendees to ask questions and receive guidance directly from a seasoned professional in the field.