Video 1: Multimeter

- Always attach the black lead to the common terminal; the red lead position varies based on the type of measurement.
- Ohm's law explains how voltage, current, and resistance relate, and a multimeter can check all three.
- To accurately check resistance, disconnect the component from any circuitry—otherwise, false readings may occur due to unintended pathways.
- A built-in feature emits a sound when two points are electrically linked, making it easy to find breaks in wires.
- When measuring voltage:
    - Choose between DC or AC depending on the power source.
    - Exercise caution, especially when working with high-voltage sources.
- When checking current:
    - The electrical path must be broken so the meter becomes part of the loop.
    - Begin with the high-current port to prevent internal damage if the flow is greater than expected.
- If the meter stops working after testing current, check the internal fuses and replace them if necessary.

Video 2: Controlling LED Brightness (PWM)

- Direct dimming with resistors or voltage drops is inefficient, especially for powerful LEDs.
- PWM controls brightness by switching LEDs on and off rapidly, with brightness based on the duty cycle.
- A higher duty cycle means more brightness; the LED receives more average power.
- Arduino uses `analogWrite` to generate PWM signals, often controlled by a potentiometer.

- A 555 timer can also create PWM signals without using a microcontroller.
- For high-power setups, a MOSFET is used to safely manage higher currents.

Video 3: ATtiny85 + WS2801 LED Project

- An LED strip runs animations controlled by a button.
- ATtiny85 is chosen over Arduino Uno for cost and size.
- It's programmed using Arduino IDE and Uno as a programmer.
- A custom shield was made to simplify wiring.
- Since ATtiny85 lacks SPI, a software SPI library is used.
- The project is still in progress with more updates expected.

Video 4: Bluetooth-Controlled LEDs with Arduino

- Uses an HC-05 Bluetooth module and Arduino Nano to control an RGB LED via phone.
- A voltage divider is used to safely connect the 3.3V-tolerant HC-05 to the 5V Arduino.
- The RGB LED is wired to Arduino pins, and color control is done via a smartphone app like *s2 Terminal*.
- Arduino code interprets Bluetooth commands to change LED colors.
- TX/RX pins must be disconnected during code upload to avoid errors.
- The video covers common issues, fragile modules, and how to avoid fakes.

Video 5: Controlling Many LEDs with Few Pins

- Shows how to control lots of LEDs (like a 4x4x4 RGB cube or 10x5 matrix) using fewer microcontroller pins.
- Uses **multiplexing** and **TLC5940 LED driver chips** to manage up to 192 LEDs efficiently.

- P-channel **MOSFETs** handle the high current needed when multiple LEDs light up together.
- LEDs are wired in a grid—rows and columns—to scan through them quickly and simulate full lighting.
- Pull-up and current-limiting resistors are added for stable performance.
- An Arduino library for TLC5940 makes coding animations like sine waves or text easier.
- Schematics and code are shared, encouraging viewers to try their own LED cube projects.

Video 6: Standalone ATmega328p Project

- Shows how to move an Arduino project to a permanent setup using just the ATmega328p chip.
- Needs a crystal, two capacitors, and a resistor to run independently.
- Lacks features like USB or reset button but works well for compact projects.
- Code can be uploaded by:
    1. Replacing the chip in an Arduino,
    2. Using Arduino as a programmer,
    3. Using an FTDI USB adapter.
- Ends with a working gadget and tips for easy reprogramming.

Video 7: Seven-Segment Displays (Basic & Arduino-Based)

- Seven-segment displays show numbers using 7 LEDs shaped like a digit.
- Each segment is labeled (A–G) and often includes a decimal point (DP).
- Displays can be single or multi-digit and usually require checking the datasheet for proper wiring.
- **Hardware-only setup**:

    - Use decoder and counter chips (e.g., SN74LS247, SN74290) to drive the display without programming.
    - Ideal for simple logic-based projects.

- **Arduino setup**:
    - For multiple digits, use a display driver like the SAA1064 via I²C.
    - Arduino libraries make coding easy and reduce processor load.
    - Good for more dynamic or interactive projects.

Video 8: Using LEDs Safely and Effectively

- Shows how to calculate resistors for LEDs using **Ohm's Law**.
- Covers LED behavior in **series vs. parallel** setups.
- Warns against running LEDs without resistors or sharing one resistor across parallel LEDs.
- Introduces **constant current circuits** (e.g., **LM317**) and mentions advanced drivers like **TLC5940**.
- Combines theory with practical tips for **longer-lasting, efficient LED setups**.

Video 9: Basics of Diodes

- Diodes let current flow in one direction, protecting against reverse polarity.
- Example: **1N4007**, with small voltage drop and power loss.
- Used in **AC to DC conversion** via **bridge rectifier**.
- **Capacitors** help reduce output ripple.
- Forms the base for power supply design; advanced diodes to be covered later.

Video 10: DAC – Digital to Analog Conversion

- Converts digital signals to analog using a **resistor ladder DAC**.

- Generates waveforms (ramp, sine, triangle) with Arduino.
- Uses an **op-amp** to stabilize DAC output under load.
- Compares with **PWM + filter** method for analog output.
- Mentions DAC ICs: **DAC0800**, **MCP4725**, **PCF8591 (I²C)**.
- Previews upcoming audio and signal projects.

Video 11: TC35 GSM Module (SMS with Arduino UNO)

- Introduces TC35 module: cost, sourcing, and hardware basics
- Use a 5V supply and avoid high voltage unless MAX232 IC is removed
- SIM card required; power on via physical login button (can be automated using Arduino pin)
- Connect to Arduino via FTDI; be mindful of pin labels and voltage levels
- Use Serial Monitor (9600 baud) to send AT commands for connectivity, network info, and signal strength
- SMS sent via Arduino code; end message with a dot (.)
- Phone number must match regional format
- Can be used for SMS alerts like in alarm systems
- Code and schematics available in video description

Video 12: Introduction to Inductors (Coils)

- Covers inductors as key passive components (with resistors & capacitors)
- Current through coil → magnetic field; stronger with more turns & ferromagnetic core
- Inductance (H) = coil's resistance to current change
- Lenz's Law: current changes gradually, opposes sudden voltage shifts
- Real-world examples: motors, relays, transformers

- Stores energy in magnetic field → used in boost converters
- Flyback diode protects from voltage spikes in switching circuits
- Smooths output in power supplies by steady energy release
- Key in PWM/motor control; manages spikes & energy flow
- Prepares for AC behavior: reactance & filtering

Video 13: Inductive Reactance & Applications

- LED fails on high voltage, works with inductor → shows reactance
- Inductors store energy via magnetic fields, resist current changes
- Higher frequency → less current
- Moving iron core changes inductance and current flow
- Inductive circuits cause voltage-current phase shift
- Inductors used in high-pass & low-pass filters
- Phase shift helps measure inductance and analyze loads
- Microwave motor shows real-world inductive behavior
- Transistor tester measures L, C, R, and gain
- Affordable tool for learning & prototyping

Video 14: Capacitors – Principles, Behavior & Applications

- Demonstrates DIY capacitor using aluminum sheets
- Capacitance depends on plate area, spacing, and dielectric
- Explains electrolytic capacitors: internal design, polarity, and voltage limits
- Covers capacitor behavior in DC (charging) vs AC (reactive flow)
- Introduces **capacitive reactance**
- Shows RC circuits for timing and frequency filtering

- Explains capacitors in reactive power compensation for inductive loads
- Encourages hands-on learning through simple experiments

Video 15: Accurate Temperature Measurement – Sensors, Circuits & Prototypes

- Explains NTC thermistors (non-linear, cost-effective) and PT100 RTDs (linear, accurate)
- Discusses resistance-based temperature sensing: lower resistance = higher temperature (NTC), opposite for PT100
- Challenges: small signal voltages, offset errors, and need for constant current
- Solutions: voltage dividers, Wheatstone bridges, differential amplifiers
- Demonstrates DIY thermometer with microcontroller, analog input, LCD display
- Recommends pre-made PT100 transmitters to simplify signal conditioning
- Introduces LM35 and DS18B20 ICs for basic temperature sensing (with slower response)
- Stresses importance in 3D printing, industry, and consumer tech

Video 16: Resistors – More Than Just Current Limiters

- Current limiting in LED circuits to prevent component damage
- Potentiometers used for adjustable voltage control (e.g., sensor inputs)
- Pull-up and pull-down resistors stabilize digital inputs from buttons or switches
- Shunt resistors allow current sensing via voltage drop measurements
- Resistors as fuses protect circuits by intentionally burning out under overload
- AC behavior: real resistors exhibit parasitic inductance and capacitance
- Non-ideal characteristics of components must be considered for accurate and reliable circuit design