

Level 1 – Introduction to Microcontrollers

- Basics of Microcontrollers
 - Difference between Microcontroller & Microprocessor
 - Applications of Microcontrollers
 - Overview of microcontroller architecture (CPU, Memory, I/O)
 - Embedded Systems Introduction
 - Popular microcontroller families (8051, PIC, AVR, Arduino, STM32)
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Level 2 – Microcontroller Architecture & Peripherals

- CPU, RAM, ROM, Flash Memory
 - I/O ports and pin configuration
 - Timers and Counters
 - Interrupts & polling
 - Analog & digital interfaces (ADC, DAC)
 - Serial communication basics (UART, SPI, I2C)
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Level 3 – Programming Basics

- Introduction to microcontroller programming
 - IDEs and compilers (Arduino IDE, MPLAB, Keil, STM32CubeIDE)
 - Writing simple programs (LED blinking, button input)
 - Digital I/O control
 - Bitwise operations & registers
 - Timer programming basics
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Level 4 – Interfacing & Sensors

- Input/output interfacing (LEDs, switches, relays)
 - Sensor interfacing (temperature, light, proximity)
 - Display interfacing (7-segment, LCD, OLED)
 - Motor control basics (DC motors, stepper motors, servo motors)
 - ADC and PWM usage
 - Simple embedded projects (temperature monitor, traffic light control)
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Level 5 – Communication & Advanced Peripherals

- Serial communication protocols (UART, SPI, I2C) advanced
 - Wireless communication basics (Bluetooth, Wi-Fi, Zigbee)
 - EEPROM and external memory interfacing
 - Interrupt-driven programming
 - Timer/counter advanced applications
 - Data logging & simple IoT integration
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Level 6 – Advanced Concepts & Applications

- Real-time operating systems (RTOS) basics
- Power management in microcontrollers
- Advanced IoT integration
- CAN, Modbus, and industrial communication protocols
- Advanced projects: Smart home automation, robotic control
- Debugging, testing, and optimization techniques

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