IoT with ESP32

🔷 MONTH 1 — Embedded Systems & Sensor Foundations

Week 1: ESP32 Architecture & Programming

- Microcontroller architecture (CPU, memory, GPIO matrix)
- Development environment setup
- Digital I/O programming
- Serial debugging techniques

🛠️ **Mini Build: LED logic controller with button interrupts**

Week 2: Sensor Systems & Data Acquisition

- Analog vs digital sensors
- DHT11, ultrasonic, IR sensors
- Sensor calibration and noise handling
- Serial data monitoring & structured logging

🛠️ **Mini Build: Multi-sensor data logger**

Week 3: Actuators & Control Logic

- PWM for motors and dimming
- Relay modules & safe switching
- Threshold-based automation
- Event-driven programming

🛠️ **Mini Build: Automatic fan control system**

Week 4 – PHASE PROJECT

🎯 **Smart Environment Monitoring System**
Features:

- **Temperature + distance sensing**
- **Local alerts**
- **Real-time control logic**
- **Modular circuit layout**

🔷 **MONTH 2 — IoT Communication & Cloud Integration**

Week 5: Networking Fundamentals

- **TCP/IP basics**
- **Wi-Fi connectivity on ESP32**
- **HTTP protocol basics**

🛠️ **Mini Build: Send sensor data to local server**

Week 6: MQTT Protocol

- **Publish–subscribe architecture**
- **Broker setup**
- **Message reliability (QoS)**

🛠️ **Mini Build: Real-time MQTT dashboard**

Week 7: Cloud Dashboard Integration

- **Cloud platforms overview**
- **API-based data upload**
- **Basic data visualization**

🛠️ **Mini Build: Live cloud dashboard**

Week 8 – PHASE PROJECT

🎯 IoT-Based Smart Room Automation

- **Remote monitoring**
- **Cloud alerts**
- **Local + remote control**

🔷 MONTH 3 — Smart IoT Product Engineering

Week 9: Power & Reliability

- **Voltage regulation**
- **Power efficiency**
- **Fault detection**

Week 10: Multi-Device Communication

- **Node-to-node messaging**
- **Structured JSON data exchange**

Week 11: Edge Preprocessing on ESP32

- **Local filtering**
- **Event-based cloud upload**

Week 12 – FINAL CAPSTONE

🎯 Industrial IoT Monitoring Prototype
(Complete hardware + communication + automation system)