COURSE TABLE OF CONTENTS

Espressif ESP-IDF Development

OEM: Espressif • Duration: 2 Days (12 hrs)

COURSE MODULES & TOPICS

Module 1: Getting Started with ESP32 and ESP-IDF

- ESP32 microcontroller overview and applications
- ESP32 development: Arduino vs ESP-IDF
- ESP-IDF architecture and framework components
- FreeRTOS overview within ESP-IDF
- Setting up ESP-IDF and VS Code extension
- ESP-IDF project structure and configuration files
- Introduction to CMake and CMakeLists.txt
- Create, build, flash and monitor a basic project

Module 2: GPIO Programming and Peripheral Interfacing

- GPIO pin functions and electrical considerations
- Configuring GPIO as digital inputs and outputs
- Using ESP-IDF GPIO driver APIs
- Push-button input and LED control
- ADC basics and analog input measurement
- PWM generation with LEDC peripheral
- GPIO interrupts and event handling
- Hands-on: LED blink, button read, ADC, PWM

Module 3: FreeRTOS and Multitasking

- RTOS concepts and FreeRTOS in ESP-IDF
- Task creation and function structure
- Task priorities, scheduling and periodic execution
- Task delays, suspension and deletion
- Inter-task communication with queues
- Synchronization using semaphores and mutexes
- Shared resources and concurrency basics
- Hands-on: Multitasking, LED blink, data exchange

Module 4: Communication Protocols and Sensor Interfacing

- Overview of UART, I2C and SPI communication
- UART configuration and serial data exchange
- I2C bus concepts and device communication
- SPI bus concepts and peripheral communication
- Using ESP-IDF peripheral drivers
- Sensor interfacing and data reading
- Serial logging and troubleshooting
- Hands-on: UART, I2C sensor, SPI demo

Module 5: Wi-Fi, Networking and IoT Development

- ESP32 wireless capabilities and Wi-Fi operation
- Wi-Fi station and access point modes
- Wi-Fi configuration and connection events
- IP addressing and networking fundamentals
- HTTP client/server communication basics
- HTTP GET and POST requests
- Introduction to MQTT and publish/subscribe
- ESP32 IoT application architecture
- Hands-on: Wi-Fi connect, web server, HTTP request

Module 6: Debugging, Advanced Concepts and Final Project

- ESP-IDF logs and monitor for debugging
- Common build, flashing and runtime errors
- Introduction to menuconfig and project configuration
- Non-Volatile Storage (NVS) for configuration data
- Overview of OTA firmware updates
- Code organization and firmware practices
- Integration of peripherals, FreeRTOS and Wi-Fi
- Hands-on: Debugging, NVS, guided IoT project