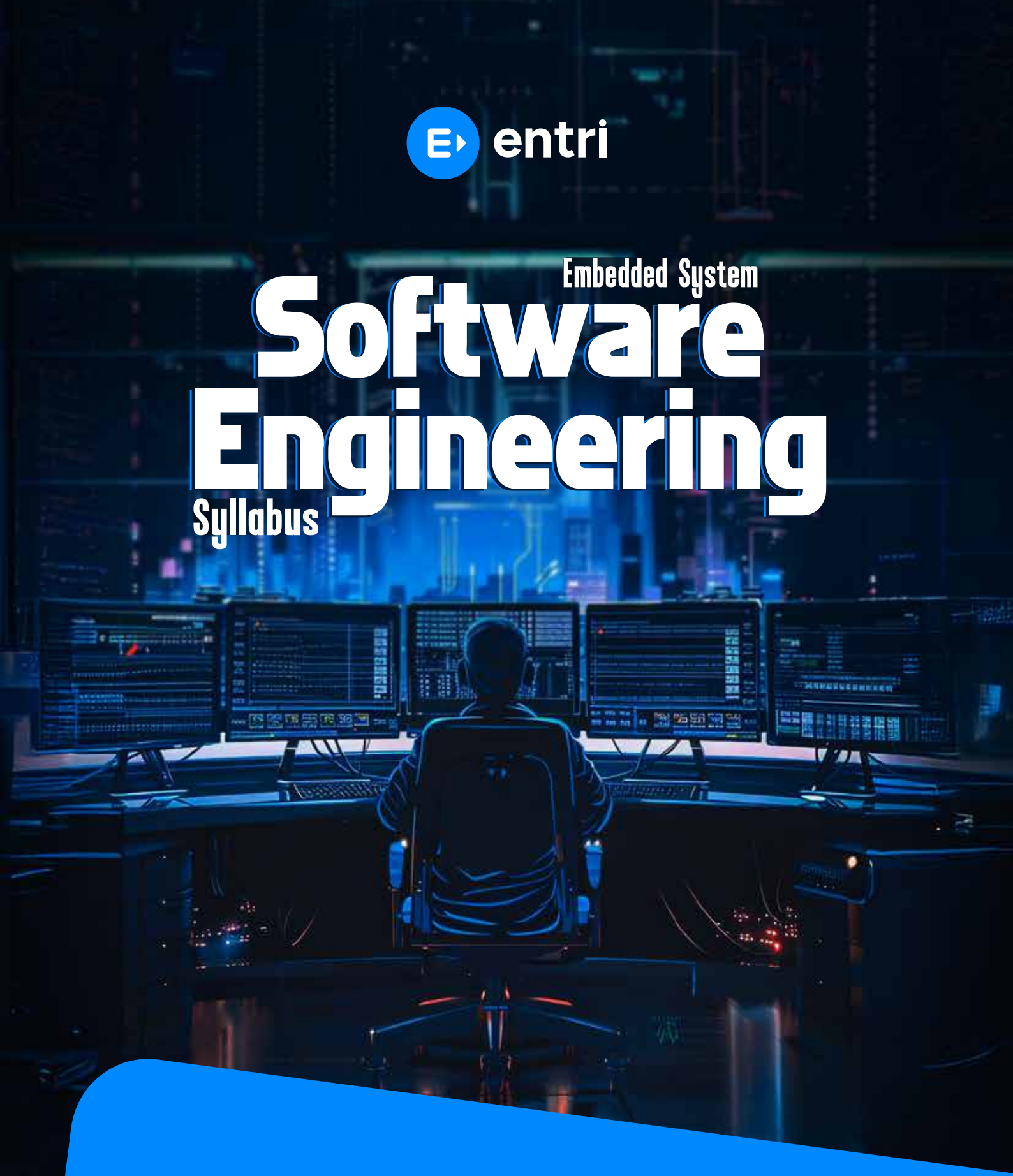
entri

Embedded System

Software Engineering

Syllabus



Introductory Sessions

- Development environment setup (AVR Studio, STM32CubeIDE, GCC)
- Git version control basics

Beginner Stage

Module 1

Introduction to Embedded C

- Basics of Embedded Systems and Microcontrollers
- Embedded C vs. Standard C
- Control structures, functions, arrays, pointers
- Memory management and bit manipulation

Module 2

AVR Microcontroller (ATmega328P)–Bare-Metal Programming

- AVR architecture: registers, memory, peripherals
- Clock systems and power management
- GPIO control and PWM (register-level)

- Interrupts and ISR design
- Communication Protocols: UART, I2C, SPI (bare-metal)

Module 3

Datasheet Navigation & **Peripheral Programming**

- Pin multiplexing, electrical characteristics
- Register maps and peripheral control
- ADC, UART driver development using C
- Hands-on: LED blinking and sensor interfacing

Intermediate Stage

Module 4

STM32F4 – Bare-Metal ARM **Cortex-M4 Development**

- Cortex-M4 architecture overview
- Manual register-level programming (GPIO, UART, SPI)
- Debugging with JTAG/SWD
- Communication Protocols: UART, I2C, SPI
- Project: Data acquisition system

Module 5

RTOS with STM32

- RTOS architecture and principles
- Task creation, scheduling, and priorities
- Inter-task communication: queues, semaphores
- RTOS debugging
- Multitasking project implementation

Module 6

ESP32 – IoT and Wireless **Firmware Development**

- ESP32 architecture overview
- Wireless Protocols: Wi-Fi, BLE
- ESP-IDF firmware development
- Secure communication (MQTT, HTTP)
- Project: Wireless sensor network

Advanced Stage

Module 7

Embedded C Advanced & **Embedded Linux Basics**

- Data structures: linked lists, stacks, queues
- Shell scripting, build systems
- Cross-compilation toolchains
- Introduction to character device drivers
- Kernel module programming (basic)

Module 8

Interview Preparation

- Technical and HR interview guidance
- Mock interviews and feedback sessions

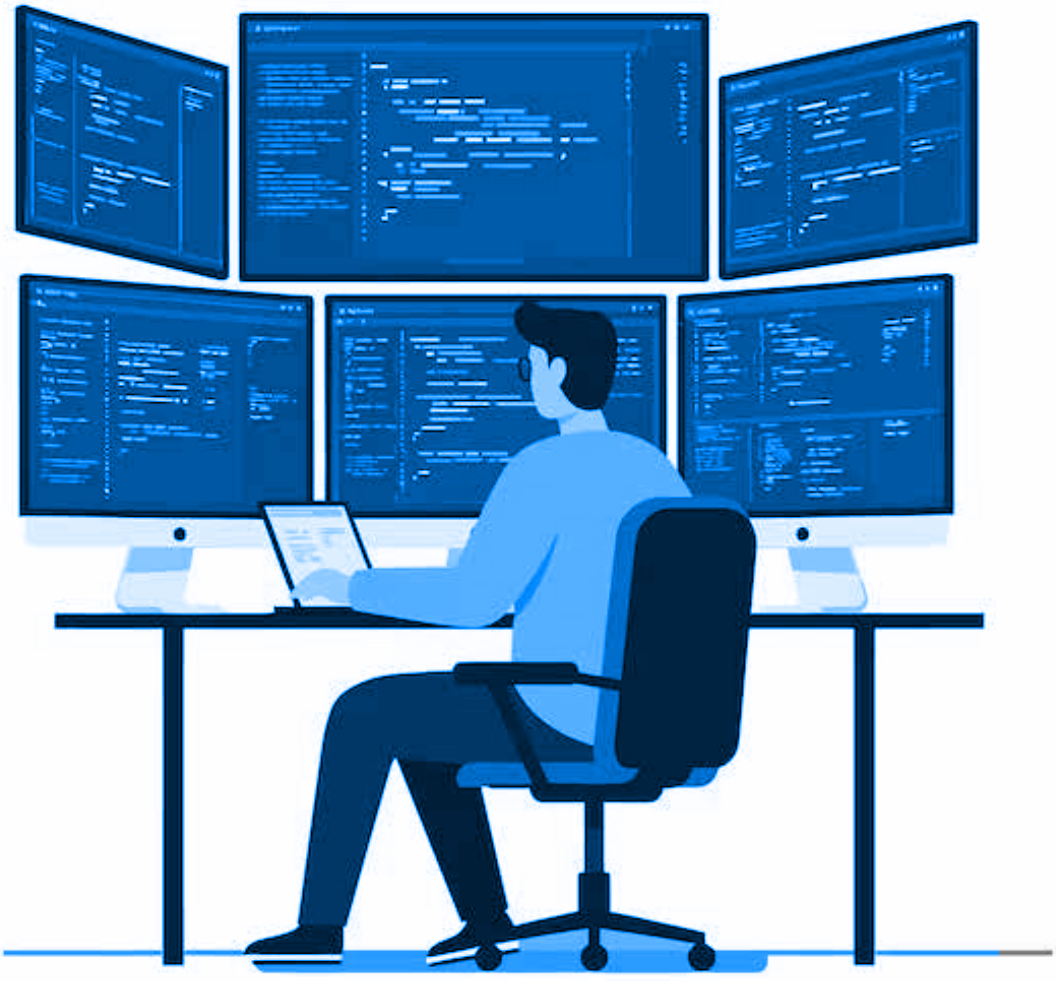
Module 9

Bonus – Edge AI & **Performance Optimization**

- Edge AI applications in embedded systems
- System-level performance tuning techniques

Capstone Industry Projects
Project Options

- Smart Home Automation System (STM32 & ESP32)
- Secure Industrial Data Logger
- Ultra-Low Power Environmental Monitor
- Edge AI Vision System
- Secure Bootloader and Firmware Update



Thank you