Embedded Firmware Design, RTOS, Microcontroller/DSP Architecture, FPGA and VHDL/Verilog Design Training Course

Professional Development Training Course Outline

Category	Engineering	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

The increasing demand for intelligent embedded systems across industries such as telecommunications, automotive, aerospace, industrial automation, medical devices, defense, and consumer electronics has created a need for engineers with advanced skills in embedded firmware development and digital hardware design. Modern embedded systems require the seamless integration of software and hardware components to achieve high performance, reliability, safety, and real-time responsiveness. Embedded Firmware Design, RTOS, Microcontroller/DSP Architecture, FPGA and VHDL/Verilog Design Training Course provides participants with comprehensive knowledge of embedded firmware development, real-time operating systems (RTOS), microcontroller and DSP architectures, and FPGA-based digital system design.

The training combines theoretical foundations with practical implementation techniques, enabling participants to design, develop, test, and optimize embedded solutions for complex applications. Through hands-on exercises and industry case studies, participants will gain expertise in firmware architecture, real-time task scheduling, signal processing implementation, FPGA programming using VHDL and Verilog, hardware-software integration, debugging, verification, and performance optimization for mission-critical embedded systems.

Programme Curriculum

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Course Objectives

By the end of the course, participants will be able to:

1. Understand the architecture and operation of modern embedded systems.
2. Design robust embedded firmware for microcontroller-based applications.
3. Implement multitasking applications using Real-Time Operating Systems (RTOS).
4. Analyze and optimize microcontroller and DSP architectures for embedded applications.
5. Develop real-time signal processing applications using DSP platforms.
6. Design digital hardware systems using FPGA technology.
7. Create FPGA applications using VHDL and Verilog Hardware Description Languages.
8. Integrate hardware and firmware components for embedded system development.
9. Apply debugging, testing, verification, and performance optimization techniques.
10. Develop complete embedded solutions for industrial, automotive, aerospace, and IoT applications.

Course Outline

Module 1: Fundamentals of Embedded Systems and Firmware Design

1. Introduction to Embedded Systems Architecture
2. Embedded Hardware Components and Interfaces
3. Embedded Software Development Lifecycle
4. Firmware Design Methodologies
5. Embedded Development Tools and Environments

Case Study

- Design and development of a smart industrial monitoring system using embedded firmware.

Module 2: Advanced Embedded Firmware Development

1. Embedded C and C++ Programming Techniques
2. Interrupt Handling and Event-Driven Programming
3. Peripheral Drivers Development
4. Memory Management and Optimization
5. Firmware Reliability and Fault Tolerance

Case Study

- Development of firmware for an automotive Electronic Control Unit (ECU).

Module 3: Real-Time Operating Systems (RTOS)

1. RTOS Fundamentals and Architecture
2. Task Scheduling and Priority Management
3. Inter-Task Communication Mechanisms
4. Synchronization and Resource Sharing
5. RTOS Performance Analysis and Optimization

Case Study

- Implementation of a real-time patient monitoring system using FreeRTOS.

Module 4: Microcontroller Architecture and Applications

1. ARM Cortex-M Architecture
2. STM32 and PIC Microcontroller Platforms
3. Timers, Interrupts, and Communication Interfaces
4. Low-Power Embedded System Design
5. Hardware Abstraction Layers (HAL)

Case Study

- Development of an IoT-enabled environmental monitoring device.

Module 5: Digital Signal Processing (DSP) Systems

1. DSP Fundamentals and Architectures
2. Signal Acquisition and Processing Techniques
3. FIR and IIR Filter Design
4. Real-Time Audio and Sensor Signal Processing
5. DSP Optimization Techniques

Case Study

- Design of a digital noise reduction system for industrial communication networks.

Module 6: FPGA Architecture and Digital System Design

1. FPGA Fundamentals and Architecture
2. Logic Elements and Configurable Resources
3. FPGA Development Tools and Design Flow
4. Hardware Acceleration Concepts
5. FPGA Applications in Embedded Systems

Case Study

- FPGA-based implementation of a high-speed data acquisition system.

Module 7: VHDL and Verilog Design Methodologies

1. Introduction to Hardware Description Languages
2. VHDL Programming and Design Techniques
3. Verilog Programming and Design Techniques
4. Simulation and Functional Verification
5. Synthesis and Timing Analysis

Case Study

- Design and implementation of a digital communication controller using VHDL and Verilog.

Module 8: Hardware-Software Co-Design, Testing and System Integration

1. Embedded Hardware-Software Co-Design Principles
2. FPGA-Microcontroller Integration
3. System Verification and Validation
4. Embedded System Security and Reliability
5. Performance Optimization and Deployment

Case Study

- End-to-end development of an FPGA-accelerated real-time image processing system for intelligent surveillance.

Training Methodology

This course employs a participatory and hands-on approach to ensure practical learning, including:

- Interactive lectures and presentations.
- Group discussions and brainstorming sessions.
- Hands-on exercises using real-world datasets.
- Role-playing and scenario-based simulations.
- Analysis of case studies to bridge theory and practice.
- Peer-to-peer learning and networking.
- Expert-led Q&A sessions.
- Continuous feedback and personalized guidance.

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	27 Nov 2026	Online	$1,000
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

Ready to enroll or request a customized program? Book online or contact us:

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Email: info@fineskilltrainingcenter.com | Website: www.fineskilltrainingcenter.com