MERCURY

Advanced Embedded Systems Design & Integration: From Hardware to Software Development

25 – 29 April 2027
Istanbul (Turkey)



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Advanced Embedded Systems Design & Integration: From Hardware to Software Development

Ref: 15801_328610 **Date:** 25 – 29 April 2027 **Location:** Istanbul (Turkey) **Fees:** 5500 Euro

Introduction:

The Advanced Embedded Systems Design, Hardware, and Software Development course explores embedded systems in today's industrial and commercial landscapes. Embedded systems, characterized by their specialized functions within larger mechanical or electrical systems, have revolutionized sectors, including automotive, healthcare, and consumer electronics. It emphasizes components of embedded systems, processors, memory, and input/output units while highlighting design considerations, including power consumption, size, cost, and performance.

Participants will engage in hands-on experiences that bridge the gap between hardware and software, enabling them to design and integrate robust embedded systems effectively. Through practical applications and project development, this Advanced Embedded Systems Design and Integration: From Hardware to Software Development course aims to equip learners with the skills to navigate the complexities of modern embedded systems, ensuring they are well-prepared to contribute to this dynamic field.

The Advanced Embedded Systems Design, Hardware, and Software Development training provides in-depth knowledge of embedded systems, covering hardware and software aspects. As an embedded systems engineer, participants will explore the definition and meaning of embedded systems and learn how to integrate hardware and software in embedded systems. It delves into embedded systems programming, including C language and C++ programming for embedded systems, equipping participants with the skills for embedded systems software development.

Participants will gain experience in embedded systems design, from designing the hardware to developing the software that drives them. The course covers the use of Linux on embedded systems and introduces embedded systems frameworks commonly used in the industry. They will learn to apply their skills through embedded systems projects, preparing them for careers as embedded systems software engineers, developers, and hardware engineers or for transitioning into the field. The foundation is in industrial embedded systems and embedded systems development.

Targeted Groups:

- Engineering students seeking specialization in embedded systems.
- Professionals in electronics and computer engineering fields.
- Software developers are transitioning to embedded systems programming.
- Hardware engineers looking to enhance their integration skills.
- Technical managers overseeing embedded systems projects.
- Researchers and developers in industrial automation and robotics.
- Hobbyists and enthusiasts interested in embedded system design.

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Course Objectives:

At the end of this Advanced Embedded Systems Design, Hardware, and Software Development course, the participants will be able to:

- Define and explain the significance of embedded systems in various industries.
- Identify and describe the core components of embedded systems.
- Analyze key design considerations impacting embedded system performance.
- Develop skills in selecting appropriate components for hardware design.
- Gain proficiency in printed circuit board design fundamentals.
- Utilize design tools like Altium Designer and KiCAD effectively.
- Set up an integrated development environment for embedded systems.
- Write and test drivers for effective hardware communication.
- Manage the integration of hardware and software components seamlessly.
- Program embedded systems using C and C++ languages.
- Employ various testing techniques to evaluate embedded systems.
- Utilize testing and analysis tools, including logic analyzers.
- Implement error debugging and performance optimization strategies.
- Optimize system signals and routing to reduce interference.
- Complete a comprehensive project from design to evaluation.
- Demonstrate practical applications of hardware-software integration.
- Evaluate project outcomes and system performance metrics.

Targeted Competencies:

By the end of this Advanced Embedded Systems Design, Hardware, and Software Development training, the participant's competencies will:

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- Understanding of embedded systems concepts and applications.
- Ability to identify core components of embedded systems.
- Proficiency in key design considerations for embedded systems.
- Skills in component selection for embedded hardware.
- Knowledge of PCB design principles and practices.
- Familiarity with design tools like Altium Designer and KiCAD.
- Competence in setting up integrated development environments.
- Ability to write and test hardware communication drivers.
- Skills in managing hardware-software configuration and integration.
- Proficiency in embedded programming using C and C++.
- Techniques for testing embedded systems effectively.
- Ability to utilize testing and analysis tools like logic analyzers.
- Skills in error debugging and performance optimization.
- Knowledge of signal planning and electromagnetic interference mitigation.
- Experience in developing comprehensive embedded system projects.
- Ability to evaluate and validate embedded systems performance.
- Understanding of practical applications of hardware-software integration.
- Skills in designing functional smart devices and control units.
- Ability to work collaboratively in project development teams.
- Understanding of industry standards and best practices in embedded systems design.

Course Content:

Unit 1: Introduction to Embedded Systems:

- Define embedded systems as dedicated computer systems within larger systems.
- Discuss the role of embedded systems in industrial automation and consumer electronics.
- Identify the core components: processors, memory, and input/output.
- Explain the functionality of processors, including microcontrollers and microprocessors.
- Describe different types of memory used in embedded systems, such as RAM, ROM, and Flash.
- Explore the significance of I/O units in data collection and device control.
- Analyze key design considerations: power consumption, size, cost, and performance metrics.
- Discuss real-world applications and case studies demonstrating embedded systems' impact.

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Unit 2: Hardware Design:

- Introduce the importance of component selection in embedded systems.
- Outline the criteria for choosing the right processor based on performance requirements.
- Discuss the selection of memory types and sizes appropriate for specific applications.
- Explain the basics of Printed Circuit Board PCB design, including schematic creation.
- Detail the process of component layout, ensuring efficient routing and minimal interference.
- Identify electrical considerations, such as signal integrity and power management strategies.
- Discuss electromagnetic interference EMI and its mitigation techniques in hardware design.
- Provide hands-on experience with PCB design tools, emphasizing Altium Designer and KiCAD.

Unit 3: Hardware-Software Integration:

- Discuss an integrated development environment IDE setup for embedded systems.
- Explain the process of writing drivers for hardware communication.
- Outline techniques for testing and debugging drivers and hardware interfaces.
- Manage hardware and software configuration to ensure seamless operation.
- Introduce embedded programming concepts using C and C++.
- Provide coding examples that illustrate basic hardware interactions.
- Discuss data structures and algorithms relevant to embedded systems programming.
- Highlight best practices for efficient coding in resource-constrained environments.

Unit 4: Embedded System Testing and Debugging:

- Introduce various testing techniques specific to embedded systems.
- Discuss functional testing to validate system performance against requirements.
- Explore hardware-in-the-loop HIL testing as a method for real-time evaluation.
- Identify testing and analysis tools, such as logic analyzers and oscilloscopes.
- Explain the significance of error debugging techniques in embedded systems.
- Provide methods for performance optimization, focusing on memory and speed.
- Discuss the importance of fine-tuning system signals to prevent interference.
- Share case studies highlighting common debugging challenges and solutions.

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Unit 5: Practical Applications and Project Development:

- Guide students through a comprehensive project to design an embedded system.
- Assist in component selection, including processors, sensors, and communication modules.
- Provide a step-by-step approach to developing software for the selected hardware.
- Facilitate practical application of hardware-software integration in projects.
- Encourage the design of innovative projects, such as smart sensors or control units.
- Emphasize the importance of iterative testing and evaluation throughout the project.
- Guide students in documenting their design process and project outcomes.
- Foster collaboration among participants to enhance project development skills.
- Conclude with presentations of final projects, showcasing embedded systems design capabilities.