Embedded Systems Development Academy

EMBD21000-13-ILT (v1.0)

Course Specification

Xilinx Embedded Academy Description:

The 4 day Xilinx Embedded Academy consists of 2 packaged courses including:

- **Embedded Systems Development (2 Days)**
- **Advanced Features and Techniques of Embedded Systems Development (2 Days)**

Price: $2600 + GST for the full 4 day Academy or $1400 + GST per 2 day course. Xilinx Training Credits accepted at 8 TC's per day.

Course Description

Xilinx FPGAs provide a new level of system design capabilities through soft MicroBlaze™ processors, hard PowerPC® processors, AXI interconnect, and silicon-efficient architectural resources. This course brings experienced FPGA designers up to speed on developing embedded systems using the Embedded Development Kit (EDK). The features and capabilities of the Xilinx MicroBlaze soft processor are also included in the lectures and labs. The hands-on labs provide experience with the development, debugging, and simulation of an embedded system.

Who Should Attend? – Engineers who are interested in developing embedded systems with the Xilinx MicroBlaze soft processor core using the Embedded Development Kit and a Xilinx FPGA

Prerequisites

- FPGA design experience; Completion of the *Essentials of FPGA Design* course or equivalent knowledge of Xilinx ISE® software implementation tools
- Basic understanding of C programming
- Some HDL modeling experience

Software Tools

- Xilinx ISE Design Suite: Embedded or System Edition 13.1

Hardware

- Architecture: Spartan®-6 and Virtex-6 FPGAs*
- Demo board: Spartan-6 FPGA SP605 or Virtex-6 FPGA ML605

After completing this comprehensive training, you will have the necessary skills to:

- Describe the various tools that encompass the Xilinx Embedded Development Kit (EDK)
- Rapidly architect an embedded system containing a MicroBlaze processor and Xilinx-supplied AXI architecture IP by using the Base System Builder (BSB)
- Utilize the Eclipse-based Software Development Kit (SDK) to develop software applications and debug software
- Create and integrate your own IP into the Project Navigator environment
- Simulate your own custom peripherals with Bus Functional Models (BFMs)

Course Outline

Day 1

- EDK Overview
- Base System Builder
- **Lab 1:** Hardware Construction with the Base System Builder
- Software Development Using SDK
- **Lab 2:** Adding and Downloading Software
- Missing the Bus – Making Connections
- Introduction to AXI
- Interrupts
- Adding Hardware to an Embedded Design
- **Lab 3:** Adding IP to a Hardware Design

Day 2

- Processor Basics
- Interfacing to the Processor System
- Designing Your Own Peripheral Using the IPIC Interface
- Installing Your Own Peripheral Using the IPIC Interface
- **Lab 4:** Building Custom AXI IP for an Embedded System
- Bus Functional Model Simulation
- **Lab 5:** BFM Simulation
- Adding Your Own IP to the Embedded System
- **Lab 6:** Integrating a Custom Peripheral

Lab Descriptions

The MicroBlaze processor labs are based on the AXI interconnect.

- **Lab 1:** Hardware Construction with the Base System Builder – Create an XPS project by using the Base System Builder to develop a basic hardware system and generate a series of netlists for the embedded design.
- **Lab 2:** Adding and Downloading Software – Complete the processes begun in Lab 1 using the SDK tools to create a software BSP and sample application. Configure the FPGA and download the application.
- **Lab 3:** Adding IP to a Hardware Design – Learn to add IP from the many choices in the IP library. Use the GUI to add a general-purpose I/O module and access internal block RAM directly from the MHS file.
- **Lab 4:** Building Custom AXI IP for an Embedded System – Create and add a custom AXI peripheral (LCD interface) to your design by using the Create or Import Peripheral Wizard.
- **Lab 5:** BFM Simulation – Use the ISim simulator to perform Bus Functional Model simulation to verify functionality of the LCD bus peripheral added in the preceding lab.
- **Lab 6:** Integrating a Custom Peripheral – Put it all together: add custom IP to the processor system, then integrate the processor sub-system with other logic in an ISE design project.

Advanced Features and Techniques of Embedded Systems Development

Advanced Features and Techniques of Embedded Systems Development provides embedded systems developers the necessary skills to develop complex embedded systems and enables them to improve their designs by using the tools available in the Embedded Development Kit (EDK). This course also helps developers understand and utilize advanced components of embedded systems design for architecting a complex system.

This course builds on the skills gained in the *Embedded Systems Development course*. Labs provide hands-on experience with the development, verification, debugging, and simulation of an embedded system. Labs use demo boards in which designs are downloaded and verified.

Embedded Systems Development

EMBD21000-7-ILT (v2.0)

Course Specification

Who Should Attend? – FPGA design engineers, system architects, and system engineers who are interested in Xilinx embedded systems development flow

Prerequisites

- *Embedded Systems Development* course or experience with embedded systems design and Xilinx EDK tools
- Basic C programming
- Basic understanding of the MicroBlaze™ processor

Software Tools

- Xilinx ISE® Design Suite: Embedded or System Edition 13.1
- Mentor Graphics ModelSim simulator 6.6d (optional)

Hardware

- Architecture: Spartan®-6 and Virtex®-6 FPGAs*
- Demo board: Spartan-6 FPGA SP605 or Virtex-6 FPGA ML605

After completing this comprehensive training, you will have the necessary skills to:

- Assemble an advanced embedded system
- Take advantage of the various Virtex and Spartan FPGA and MicroBlaze processor features, including the crossbar, AXI interconnect, and multi-port memory controller
- Apply advanced debugging techniques, including the use of the ChipScope™ tool for debugging an embedded system and HDL system simulation of processor-based designs
- Identify the steps involved in integrating a memory controller into an embedded system using the MicroBlaze processor
- Integrate an interrupt controller and interrupt handler into your embedded design
- Design a Flash memory-based system and boot load from off-chip Flash memory
- Perform HDL-based system simulation with an embedded processor

Course Outline

Day 1

- Embedded Systems Development Review
- **Lab 1:** Building a Complete Embedded System
- Processor Crossbar Interconnect
- Debugging Using the ChipScope Pro Analyzer
- **Lab 2:** Debugging Using the ChipScope Pro Analyzer
- Block RAM Memory Controllers
- External Memory Controllers for Static Memory
- Memory Controllers for Dynamic RAM
- **Lab 3:** Instantiating a DDR Memory Controller

Day 2

- Interrupts
- AXI Streaming Interface
- Advance AXI Concepts
- Advanced Processor and Peripheral Interface Options
- **Lab 4:** Measuring AXI DMA Performance
- Advanced Processor Configurations
- Boot Loader
- **Lab 5:** Boot Loading from Flash Memory
- HDL System Simulation in XPS
- **Lab 6:** Simulating an Embedded Processor System

Lab Descriptions

- **Lab 1:** Building a Complete Embedded System – Develop hardware that incorporates IP cores to interface to push buttons, a rotary switch, LEDs, an LCD display, and serial communication. Use the SDK development tools to create an embedded software application project for the hardware built.
- **Lab 2:** Debugging Using the ChipScope Pro Analyzer – Perform simultaneous hardware and software debugging with the ChipScope™ Pro Analyzer, SDK Debug perspective, and XMD.
- **Lab 3:** Instantiating a DDR Memory Controller – Use XPS to instantiate a DDR memory controller. Explore memory device configurations and proper memory controller clocking procedures.
- **Lab 4:** Measuring AXI DMA Performance – Become familiar with the Embedded Targeted Reference Design (TRD) for the SP605 evaluation board. Add an AXI-based CDMA controller and a custom DMA performance analyzer. Launch the web server application and browse to this hardware platform.
- **Lab 5:** Boot Loading from Flash Memory – Develop an application that is stored in flash memory, load it through a boot loader program, and execute the software from external memory.
- **Lab 6:** Simulating an Embedded Processor System – Set up and perform HDL-based simulation on a design that contains an embedded processor system. Explore the tool flow for performing embedded processor simulation as part of a Project Navigator design in the ISE software.

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Black Box Consulting
PO Box 1147
Stafford City
QLD 4053

Tel: + 61 7 3137 0905 Fax: +61 7 3 3103 4297

info@blackboxconsulting.com.au

www.blackboxconsulting.com.au