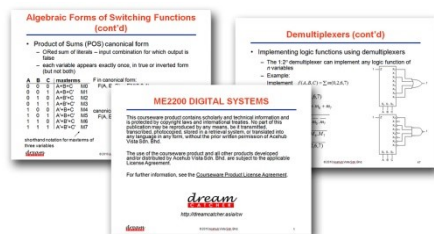# ME2200

Digital Systems Courseware

dream CATCHER

~Complete Resources for Lecturers~

KEYSIGHT TECHNOLOGIES
Solutions Partner
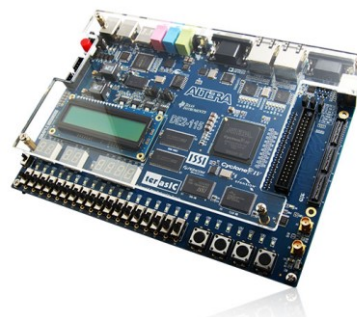Extending our solutions to meet your needs

Teaching slides	Training kit
• Editable Microsoft® PowerPoint® slides • Covers 90 hours of teaching	• Altera DE2-115 development and education board • Altera Quartus II EDA software • Lab sheets & model answers • Problem-based assignments • Covers 15 hours of labs

Target university subject	Target year of study	Prerequisite(s)
Fundamentals of Digital Logic	2nd year undergraduate	None
Digital Systems	3rd year undergraduate	Fundamentals of Digital Logic

The **ME2200 serves as a ready-to-teach package in the areas of digital system design, verification, and implementation using the FPGA platform. This is a lecturer resource consisting of teaching slides, training kits, lab sheets, and problem-based assignments.**

Designed to impart knowledge in

- ➢ Digital logic fundamentals
- ➢ Digital logic design
- ➢ Digital building block design
- ➢ Verilog coding
- ➢ EDA tools usage

- ➢ Design verification
- ➢ RTL design
- ➢ I/O core design
- ➢ FPGA applications
- ➢ Measurement instruments usage

Benefits of the ME2200 courseware

- ➢ Two complete sets of teaching material are provided in editable format, allowing lecturers to introduce a basic course (Fundamentals of Digital Logic) and an advanced course (Digital Systems).
- ➢ The Altera DE2 development and education board with various on-board I/O interfaces provides students with practical skills in FPGA implementation.
- ➢ Lab sheets are specially designed to allow students to gain exposure on FPGA design tools, as well as measurement instruments such as mixed signal oscilloscopes.

Teaching Slides

More than 850 editable Microsoft PowerPoint teaching slides, covering 90 hours of teaching for two full semesters are provided. The slides cover the following topics:

Fundamentals of Digital Logic[1]

- Introduction to Logic Circuits
- Optimized Implementation of Logic Functions
- Flip-Flops, Registers, and Counters
- Number Representation and Arithmetic Circuits
- Finite State Machines
- Static Random Access Memory
- Implementation Technology
- Faster Adders
- Flip-Flop Timing

Digital Systems

- Introduction to Logic Circuits
- Design Methodology and CAD Tools
- Combinational Circuits
- Sequential Circuits
- Pipelined Design
- Programmable Logic Devices (PLD)
- Verilog Design for FPGA Implementation
- Register Transfers and Sequencing
- Verilog Testbench
- I/O Core Design
- Synthesis Options

[1] Teaching slides courtesy of Prof. Stephen Brown, University of Toronto, Canada.

Training Kit

Altera DE2-115 development and education board

The courseware is designed to work with the Altera DE2-115 development and education board.

The Cyclone EP4CE115 device equipped on the DE2-115 features 114,480 logic elements (LEs), the largest offered in the Cyclone IV E series, up to 3.9-Mbits of RAM, and 266 multipliers.

The DE2-115 adopts similar features from the earlier DE2 series primarily the DE2-70, as well as additional interfaces to support mainstream protocols including Gigabit Ethernet (GbE). A High-Speed Mezzanine Card (HSMC) connector is provided to support additional functionality and connectivity via HSMC daughter cards and cables.
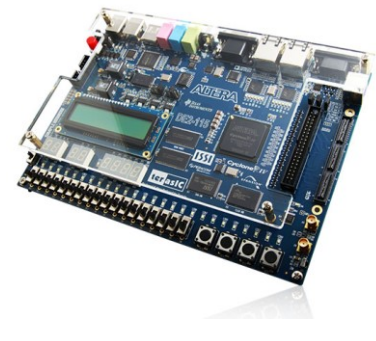
Note: The manufacturer warrants its products against defects in materials and workmanship for a period of 90 days from the date of purchase.

Altera Quartus II EDA software

The courseware uses the Altera Quartus II Web Edition EDA software for design entry, compilation, analysis, and verification.

Note: A PC with Windows® XP, Windows® Vista or Windows® 7 is required to run the Altera Quartus II software.

Lab sheets

The training kit includes 11 lab sheets on Digital Systems, in editable Microsoft Word format. All labs require the Altera Quartus II software. Each lab requires 3 hours to complete. Model answers are provided with all lab sheets. The required training kit hardware and recommended instruments for the labs are listed below.

Lab Sheet	Hardware Kit DE2-115[1]	Optional Items Mixed Signal Oscilloscope
Introduction to FPGA EDA Tool (Quartus II)		
Basic Logic Design and I/O Interface	√	
Serial Data and Waveform Generations	√	√
Design Optimization and Pipelining		√
Verilog Design and Simulation with Quartus II		
Verilog I/O Interfacing	√	
Verilog Testbench[2]		
PS/2 Keyboard and LCD Display Interfacing[3]	√	√
Memory Interfacing and Analysis	√	√
Data Processing Algorithm Debugging[4]	√	√

[1] A separate set of lab sheets for the Altera DE1 development board is also included, for existing DE1 users.
[2] Requires the ModelSim-Altera Web Edition (downloadable).
[3] Requires a PS/2 keyboard (not included).
[4] Requires a VGA monitor (not included).

Problem-based assignments

The problem-based assignments below allow students to enhance their problem-solving skills.

- Number Guessing Game
- Creative Gaming Using Verilog Design

Instruments ────────────────────────

The recommended instruments and accessories from Keysight Technologies, to be purchased separately, are listed below.

Instrument / Accessory[1]	Model[2]
Mixed Signal Oscilloscope	MSOX3012A Oscilloscope[3]: 100MHz, 2 analog & 16 digital channels

[1] Refer to the Lab sheets section for the instrument selection.
[2] The instruments and accessories shown are recommended, but may be replaced by other models with equivalent performance.
    – MSO: 100 MHz, 2 analog & 16 digital channels
[3] These instruments are also the recommended models for ME1100, ME1120, ME2000, ME2100, ME2200, ME2300, ME3000, ME3100 and ME3200.

Ordering Information

Description	Package	Product Number
Teaching Slides	1 user license	ME2200-100
Training Kit[	1 unit	ME2200-220
Teaching Slides + Training Kit	1 user license + 1 unit	ME2200-320
Instruments	where applicable	Purchase separately from Keysight or its distributor