Digital Design with Verilog

Lecture 1: Introduction and Course Outline

Logistics

- Instructor

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Dr. Debasish Nayak, *Sr. Asst. Professor, Silicon University*
Prof. Joy Chowdhury, *Assistant Professor, Silicon University*

- Lectures

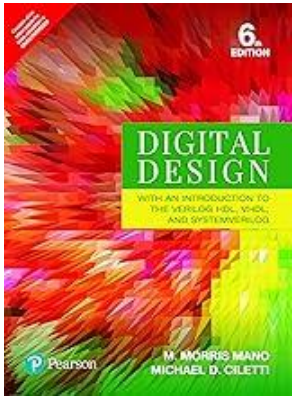
Monday -Friday: 10.00 AM– 1 PM, SIT 655

- Labs/ Handon

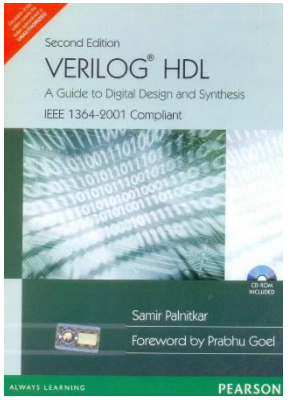
Monday -Friday: 2.30 PM– 5.30 PM

Logistics: Contd.

- Textbooks
  - Digital Design by M. Morris Mano, 6th Edition



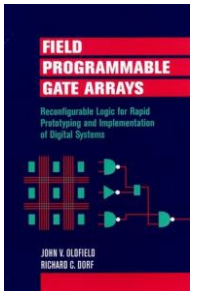
  - Verilog HDL by Samir Palnitkar



Logistics: Contd.

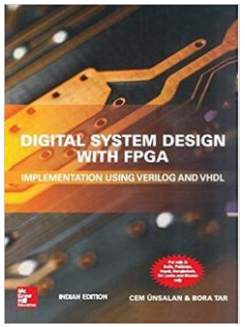
- Textbooks
  - Advanced FPGA Design: Architecture, Implementation, and Optimization by Steve Kilts. ISBN: 9780470054376, Publishers: Wiley, 2007.

  - Field-Programmable Gate Arrays: Reconfigurable Logic for Rapid Prototyping and Implementation of Digital Systems by Richard C. Dorf, John V. Oldfield. Wiley, 2008.

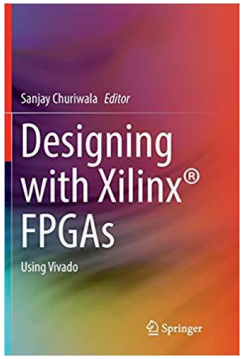


Logistics: Contd.

- Textbooks
  - Digital System Design with FPGA: Implementation Using Verilog and VHDL by CemUnsalan, Bora Tar, ISBN: 9781259837906, McGrawHill Publications.

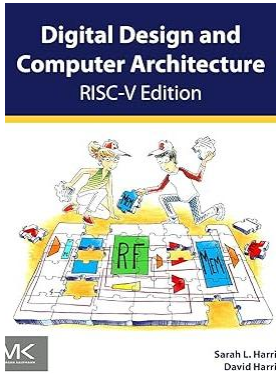


  - Designing with Xilinx FPGAs using Vivado, Editor, Sanjay Churiwala, Springer 2016.

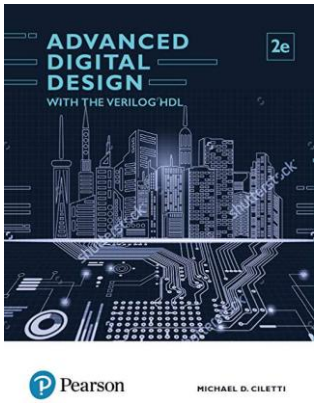


Logistics: Contd.

- Reference books
  - Digital Design and Computer Architecture, RISC-V Edition by Sarah L. Harris and David Harris



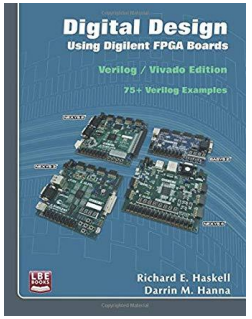
  - Advanced Digital Design with the Verilog HDL (2nd Edition 2017) by Michael D.Ciletti.



Logistics: Contd.

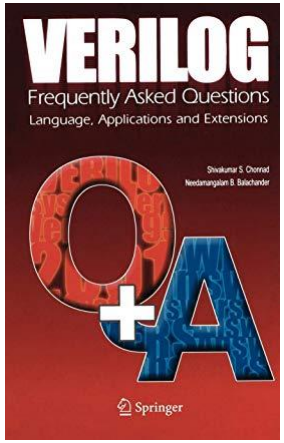
- Reference books
  - Programming FPGAs-Getting Started with Verilog by Simon Monk, ISBN: 978-1259643767, McGrawHill Publications

  - Digital Design Using Digilent FPGA Boards: Verilog / Vivado Edition by Richard E Haskell and Darrin M Hanna; LBE Books.

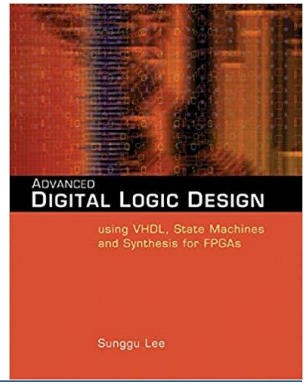


Logistics: Contd.

- Reference books
  - Verilog: Frequently Asked Questions: by Shivakumar S. Chonnad, Needamangalam B. Balachander. Springer, 2007.



  - Advanced Digital Logic Design by Sunggu Lee. ISBN: 978-0534466022, Nelson Engineering, 2005.



Course Philosophy and Objective

- Familiarize students with state-of-the-art design methodologies through practical design applications.
- Learn and design complete systems with FPGAs that includes coding, testing, synthesizing and implementation.
- In this process, you will also learn the best coding practices, and optimize the design for performance, area, and power.
- The main objective of the course is "**Learn by doing rather than just reading**".
- Try and experiment a lot through the labs/practical and coding exercises.

Modern Digital Design

- Real logic designs are too large to solve by straight theoretical approach

- Today's methodology

  - Requires use of subdivision of a system into Logical Building Blocks. Far above the gate level of AND/OR gates but far below the processor level.

  - Use of CAD

  - Use of PLDs and FPGA---state of the art programmable chips.

Course Outline

- Review of combinational and sequential logic design

- Logic design with Verilog:
  - Introduction to Verilog, logic design with behavioral models of combinational and sequential logic

- Verilog Synthesis

  - Synthesis of combinational and sequential logic, design and synthesis of data path controllers, programmable logic and storage devices, algorithms and architectures for digital processors, architectures for arithmetic processors.

Course Outline

- Introduction to FPGA architectures:
  - Overview, programming technologies, configurable logic block, FPGA routing architectures.
- Designing with FPGAs:
  - Design flow for FPGAs, prototyping with FPGAs, and debugging.
- Course Project: RISC-V

Outline for today's lecture

- Modern Digital Circuit Design
- Digital Design Methodology
- IC Technology Options

Modern Digital Circuit Design

- In today's world digital circuits, both combinational and sequential, have millions of gates and several hundred, if not thousands, of inputs and outputs.

- How do you handle this?

  - Beyond the scope of human comprehension

  - EDA tools are inevitable

Specification

- Describes exactly what the circuit of system is supposed to do.
- All inputs and outputs (interfaces) are accurately specified.
- The internal function performed is fully specified.
  - Algorithm implemented is documented
  - Data format and transformations are specified
- Timing is clear and precise
  - Timing is everything

Documentation

- Good documentation is essential for correct design and efficient maintenance of digital systems.
  - Accurate, complete, and understandable.
  - Instructive to a test engineer
  - Even the original design engineer can figure out how the system works just by reading the documentation.
- The starting place is a good specification of the circuit or system.

Other aspects of documentation

- Block Diagram
- Schematic Diagram
- Timing Diagram
- Structured Logic Description
  - HDL description both documents and allows for simulation and synthesis of the design
- Circuit Description

Block Diagrams

- Shows inputs and outputs and functional modules

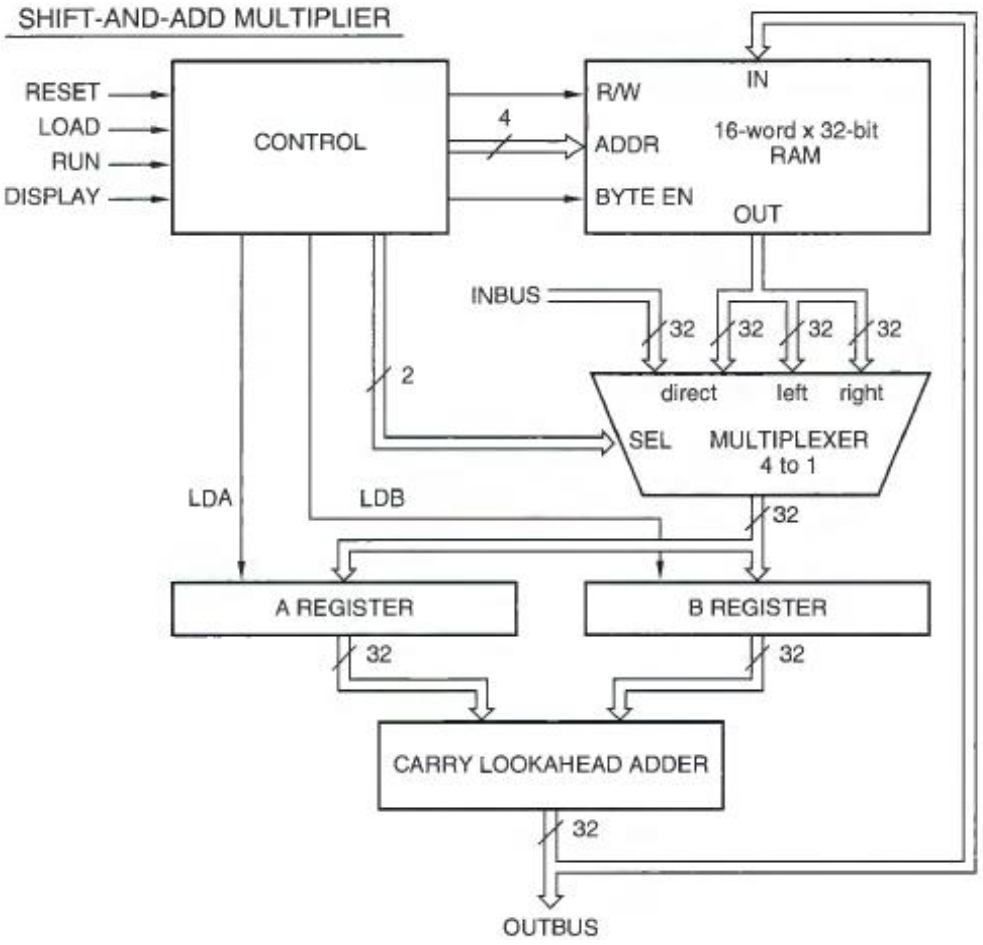
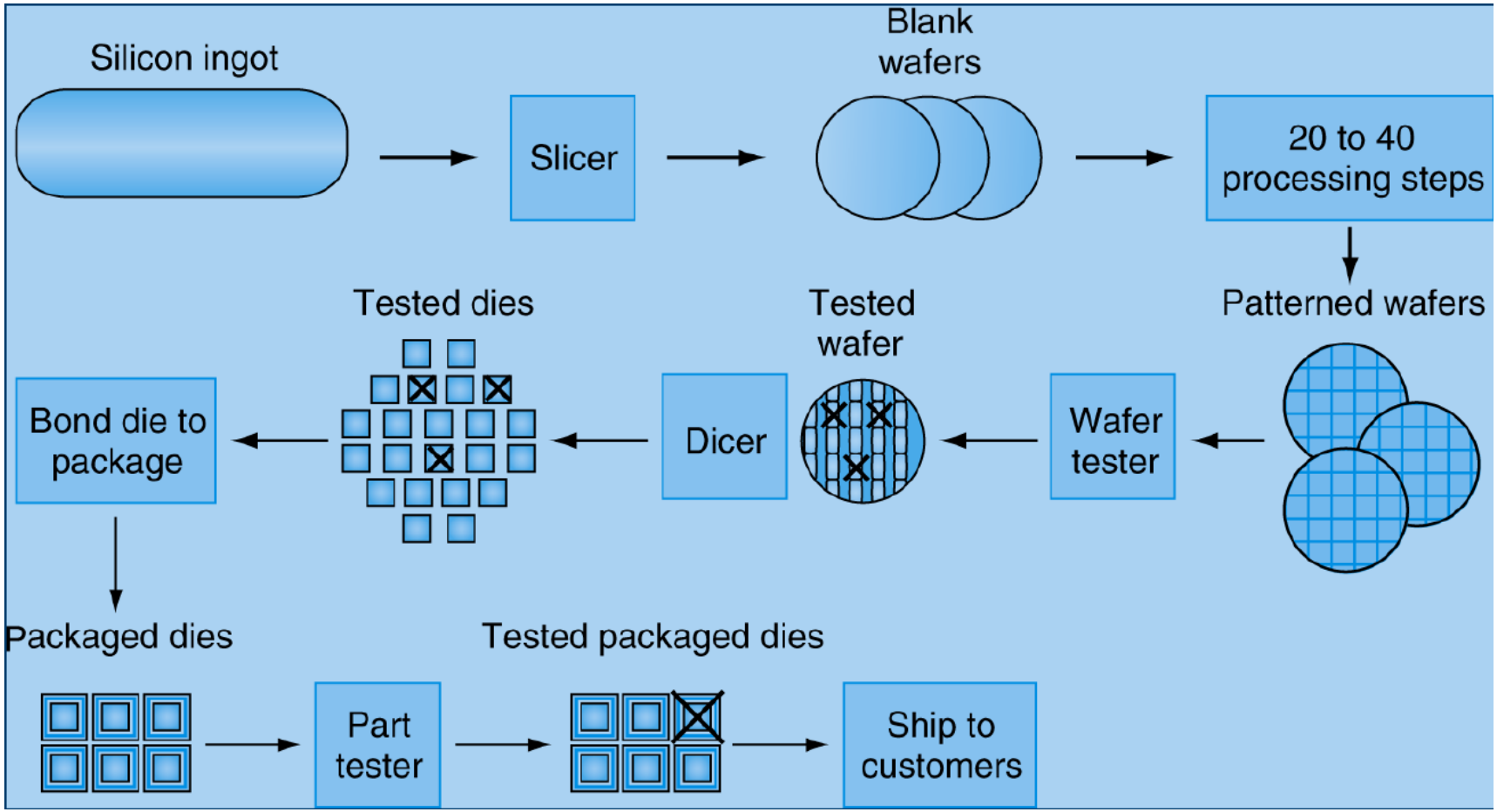


Figure 6-1
Block diagram for a digital design project.

IC Manufacturing Process



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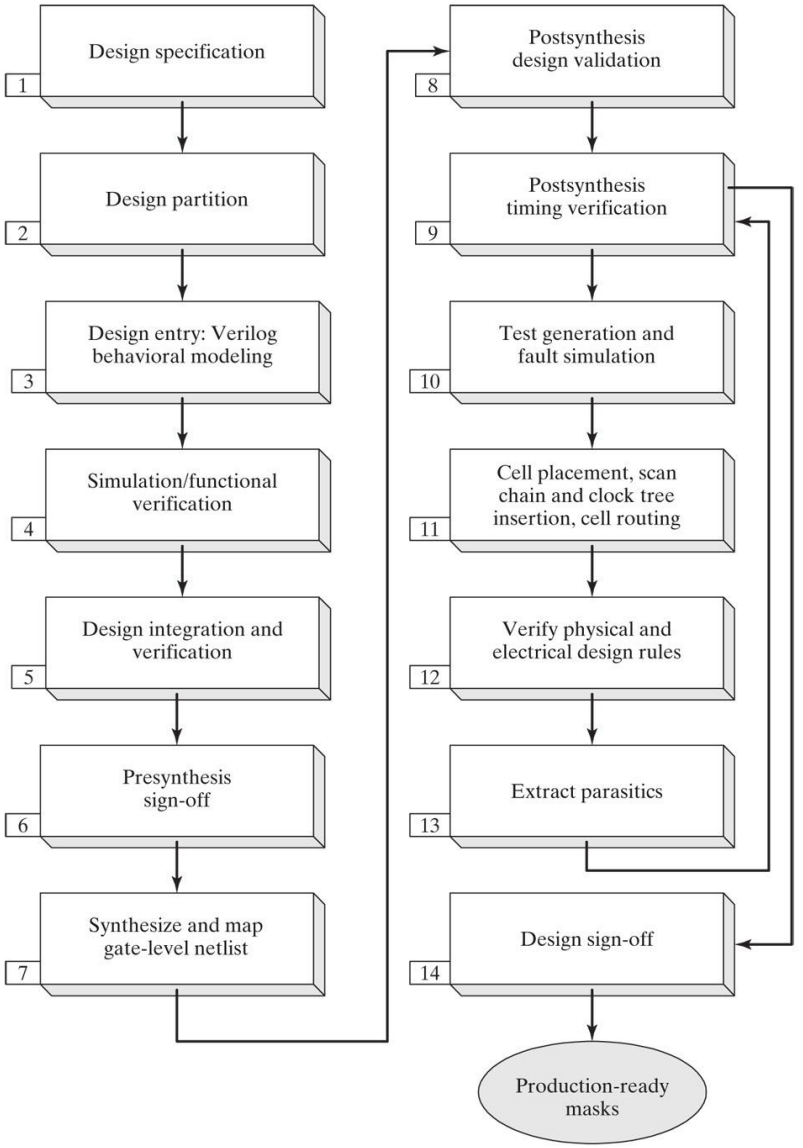
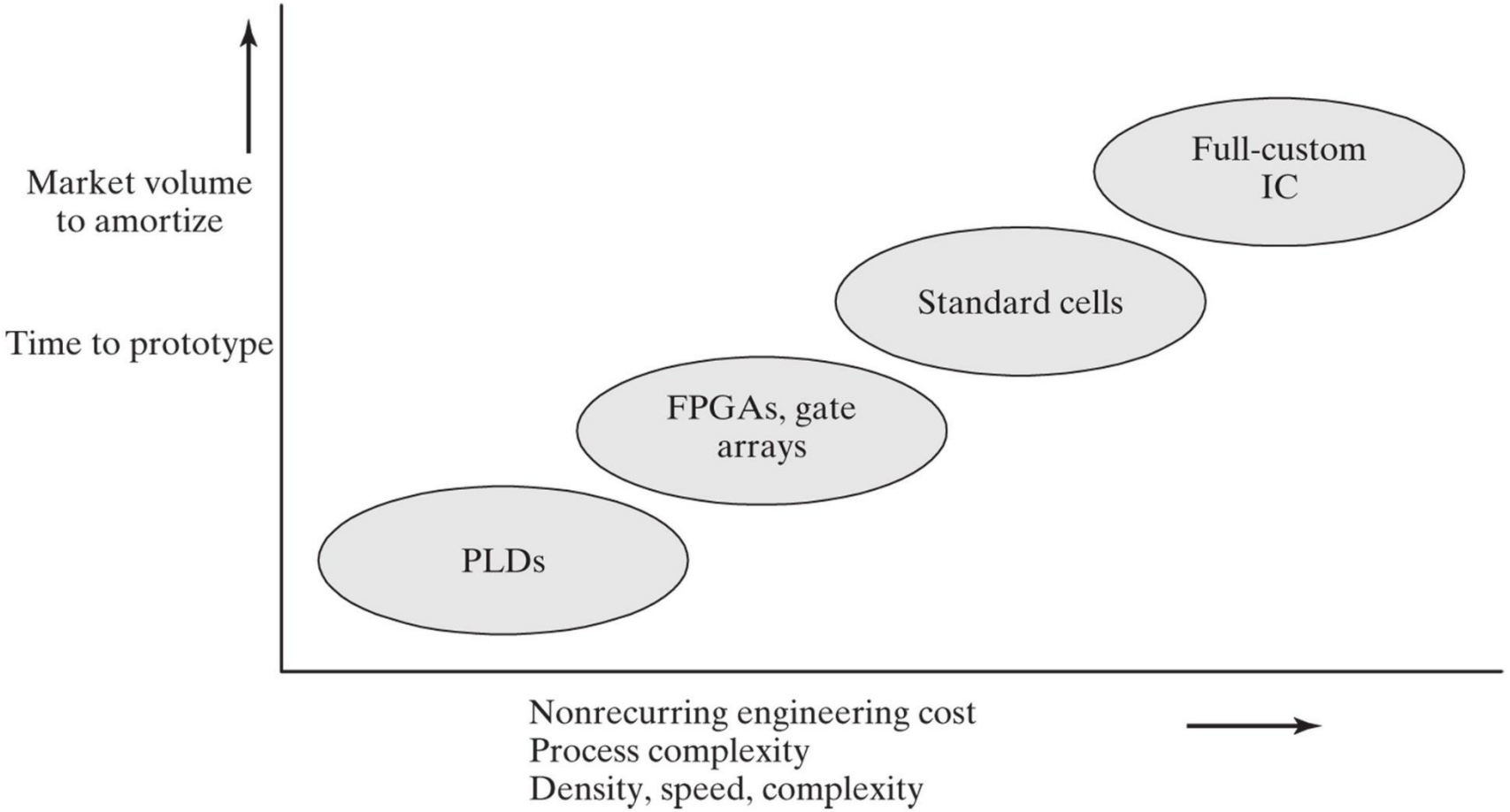
IC Manufacturing Process

Digital Design Methodology



IC Technology Options



Alternative technologies for IC implementation

References

- Advanced Digital Design with the Verilog HDL (2nd Edition 2017) by Michael D.Ciletti.

- Digital Design: Principles and Practices by John F. Wakerly.

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Thank you