

CSE 591 System on Chip Design January 2017

Instructor: Professor R. Sridhar, 338K Davis Hall Email: rsridhar@buffalo.edu

Website: <http://www.cse.buffalo.edu/~rsridhar/cse591> **Lecture:** Friday, Saturday: 9:30 PM - 5:30 PM,

Reference Material:

1. CMOS VLSI Design: Circuits and Systems Perspective, by N Weste and D. Harris, Fourth edition, Addison Wesley, 2010
2. Digital Integrated Circuits, Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic'. Second Edition, A Prentice-Hall, 2003
3. ARM System-on-Chip Architecture, 2nd Edition, Addison Wesley, Pearson Education, 2000
4. Verilog Tutorial (online)
5. System C Tutorials
6. Other material introduced in class and on the website

Course Prerequisites:

Basic background in digital systems and computer organization will be helpful.

Course Description:

This course will focus on many dimensions of System-On-Chip (SOC) designs. Most current systems (Computing, communication and entertainment systems in many domains, such as healthcare and automobiles) have at least one or more SoCs, which are key to their functioning. System-on-chip techniques integrate multiple functionalities into a single chip, by integrating processing, communication, memories, DSPs and more. These are often developed by multiple vendors and need to be adapted with ease, without losing the rights to the intellectual property. SoCs are developed through sound CAD, architecture and system level techniques and with close interactions of the hardware and software embedded within the application domain. With decreasing feature size and increased integration, many challenges have emerged in the design, test, and verification of SoCs. Low power, reliable and secure SoC designs are vital to get most consumer products to market in time.

The course will present these diverse topics of SoCs with particular focus on embedded systems, computer architecture and VLSI Systems.

Digital Systems and VLSI:

- ❖ Introduction to VLSI; design metrics; Levels of Abstraction
- ❖ Logic Styles, Combinational logic, layout, design rules; Low power Design strategies
- ❖ Simulation; CAD tools
- ❖ ALU, Memories, Arithmetic, Clocking
- ❖ Emerging topics; Deep submicron factors, Variability & Design for Manufacturing
- ❖ System design; System level approaches

ARM Core:

- ❖ ARM Processor IP
- ❖ ARM Processor architecture
- ❖ ARM Instruction Set
- ❖ Various types of operations
- ❖ AMBA Interface
- ❖ Applications

SoC Topics:

- ❖ Integration
- ❖ Hardware Description Language (Introduction to Verilog/VHDL)
- ❖ Synthesis to target design
- ❖ Hardware/Software CoDesign issues
- ❖ Embedded Applications
- ❖ IP Protection; IP reuse
- ❖ Popular devices with SoCs
- ❖ Current trends in SoC

Prototyping and Verification:

- ❖ Field Programmable Gate Arrays
- ❖ Xilinx, Altera and their approach to SoC
- ❖ Verification (Basic Introduction to System C)
- ❖ Tradeoffs – cost – time-to-market, power and performance
- ❖ Security topics in the context of SoC

Course Organization:

Class will be traditional lecture based, with presentations. Student participation and interactions will be encouraged throughout

Hands on experience with Verilog, and CAD Tools.

Grading Policy:

Two projects (use of tools towards designs) and one homework will be used along with two midterm tests, and one final exam for grading.

The tentative weights are as follows: Homework - 5%, Midterm 1 - 15% (to be given on Jan 20th), Midterm 2 - 15% (to be given on Jan 21st), Projects - 15%, Final Exam - 50% (to be given on Jan 28th).

Grade Assignment: (Letter grades carry normal numerical values)

(91-100 = A, 89-90 = A-, 87-88 = B+, 81-86 = B, 79-80 = B-, 77-78 = C+, 71-76 = C, 66-70 = C-, 60-65 = D, 1-59 = F).

All academic work must be your own. Collaboration, usually evidenced by unjustifiable similarity in any graded work, is never allowed. After an appropriate informal review, if any students are found in violation of maintaining academic integrity, sanctions will be imposed, which can be as severe as receiving an F in the course. Especially flagrant violations will be considered under formal review proceedings, which can call for harsher sanctions including expulsion from the University. If you ever have any questions or concerns regarding the policy, particularly as it relates to this course, see your instructor. The departmental statement on academic integrity is posted at http://www.cse.buffalo.edu/undergrad/policy_academic.php

It is your responsibility to maintain the security of your computer accounts and your written work. Do not share passwords with anyone, nor write your password down where it may be seen by others. Do not change permissions to allow others to read your course directories and files. Do not walk away from a workstation without logging out. These are your responsibilities. In groups that collaborate inappropriately, it may be impossible to determine who has offered work to others in the group, who has received work, and who may have inadvertently made their work available to the others by failure to maintain adequate personal security; in such cases, all will be held equally liable.