EE 434
Homework 1
Fall 2006
Due Friday Aug. 25

Problem 1 Assume a simple circuit requires 100 MOS transistors on a die and that all transistors are minimum sized. If the transistors are fabricated in a .13μ CMOS process and the spacing overhead for the transistors is a factor of 10, determine the number of die that can be fabricated on an 12" silicon wafer. Neglect the area required for the bonding pads of the circuit.

Problem 2 If the cost of a 12 inch wafer is $3200, what is the cost/die for the circuit in Problem 1.

Problem 3 For small circuits, the area required for bonding pads often dominates the area required for a circuit whereas for large circuits, the bonding pad area is a minor contributor to the overall die area. If bonding pads are square and of area 80μ x 80μ and the spacing between bonding pads and between any circuit components is 40μ, determine the number of die for the 100 transistor circuit of Problem 1 if the circuit requires 8 bonding pads. What is the cost/die if the bonding pads are included?

Problem 4 How many .08μ transistors could be placed on a die that has the same area as the cross-section of a human hair?

Problem 5 What is the minimum feature size on a Pentium 4 processor? How many transistors are in this processor? What is the clock speed of this processor?

Problem 6 Data is stored in many different ways but today the most popular strategies for storage that can be rapidly retrieved are CDs, DVDs, hard disks, static memory (SRAM) and dynamic memory (DRAM). The first two store data physically on metal/plastic media and retrieve it optically. Hard disks store data magnetically. SRAM and DRAM store data electronically in semiconductor materials. Make a comparison of the storage density (bits per cm^2) and the cost of storage per bit in these 5 different media. In making this comparison, try to use state of the art parts or components and, when appropriate, state which part you are using and the approximate cost for the component or device.

The VLSI designer is often expected to understand system requirements as well as or better than the end customer and a basic understanding of the "big picture" throughout the application domain is important. The following questions relate to the "big picture" issue. Periodically throughout this course we will attempt to present "big picture" questions and I welcome suggestions for "big picture" issues that you believe are important. You may need to draw on a variety of resources for solving these problems but will likely not get the solution from the text for this course or from any standard text book.

Problem 7 Determine the number of seconds of "telephone quality" audio (mono) that can be stored on a CD, DVD, and a state of the art SRAM and DRAM if no compression is used. Industry band limits such audio channels to 4KHz and does Nyquist rate sampling at the 8 bit level. (An industry standard of 64Kbits/sec is reserved for channels carrying uncompressed "telephone quality" audio).

Problem 8 What is the resolution level and sampling rate used by the audio industry for commercial CDs? How many channels of audio are included on a CD? Based upon the run length of an audio CD, determine the level of compression the industry is using.

Problem 9 Determine the effective number of bits/second that are required to store standard color video data for a high-end NTSC monitors. From this determine, the number of minutes of video that can be stored on a DVD. Compare this with the typical maximum length of a commercial DVD and explain the major factors contributing to the differences you observe.