Homework 2

1) Consider the operation of a machine with the data path of figure 2-2. Suppose that loading the ALU input registers takes 5 nsec, running the ALU takes 10 nsec, and storing the result back in the register scratchpad takes 5 nsec. What is the maximum number of MIPS this machine is capable of in the absence of pipelining?

3) On computer 1, all instructions take 10 nsec to execute. On computer 2, they all take 5 nsec to execute. Can you say for certain that computer is faster? Discuss.

12) Devise a 7 bit even parity Hamming code for the digits 0 to 9.

14) In a hamming code, some bits are wasted in the sense that they are used for checking and not information. What is the percentage of wasted bits for messages whose total length (data + check bits) is $2^n - 1$? Evaluate this expression numerically for values of n from 3 to 10?

17) The disk illustrated in Figure 2-19 has 1024 sectors/track and a rotation rate of 7200 RPM. What is the sustained transfer rate of the disk over one track?

22) What is the exact data capacity (in bytes) of a mode 2 CD-ROM containing the now standard 80 min media? What is the capacity for user data in mode 1?

23) To burn a CD-R, the laser must pulse on and off at a high speed. When running at 10x speed in mode 1, what is the pulse length, in nanoseconds?

24) To be able to fit 133 minute worth of video on a single sided single layer DVD, a fair amount of compression is required. Calculate the compression factor required. Assume that 3.5GB of space is available for the video track, that the image resolution is 720*480 pixels with 24-bit color, and images are displayed at 30 frames/sec.
32) A digital camera has a resolution of 3000*2000 pixels, with 3 bytes/pixel for RGB color. The manufacturer of the camera wants to be able to write a JPEG image at a 5x compression factor to the flash memory in 2 sec. What data rate is required?

33) A high end digital camera has a sensor with 16 million pixels, each with 6 bytes/pixel. How many pictures can be stored on a 8 GB flash memory card if the compression factor is 5x? Assume that 1 GB means $2^{30}$ bytes.