CSE 401: Computer Engineering (2)
Fourth Year, Electronics & Communication Engineering

Assignment #2

Due date: **Wednesday, April 13th, 2016**

1. Consider a 256 GB hard disk drive with the following parameters: 6.5 ms average seek time, 2.5 ms average rotational delay, 100 MB/s maximum data rate, 65536 tracks per surface, 2048 bytes per sector.
   (a) What is the spindle speed (in r.p.m)?
   (b) What is the number of sectors per track?
   (c) What is the number of heads per cylinder?
   (d) Consider a long sequence of accesses to some data blocks which are randomly located on the disk. Assume that each block occupies contiguous sectors on the same cylinder, and its average size is 0.1 MB. Estimate the average percentage of the total time occupied by seek operations and rotational delays.

2. A CD-ROM drive operates at a constant linear velocity of 1.2 m/s and a constant data rate of 150 KB/s. Suppose the length of the CD-ROM track is 5.38 Km.
   (a) What is the linear data density of the CD-ROM disk (in B/mm)?
   (b) What is the storage capacity of the CD-ROM disk (in MB)?

3. A RAID array is to be built using 12 disk drives. The storage capacity of each drive is 2 TB. For each of the following cases, specify which RAID level is referred to by the given description and how much data can be stored by the array in this case.
   (a) Block-level stripping with distributed parity
   (b) Bit-level stripping with Hamming error correction codes (ECC)
   (c) Mirroring without stripping or parity

4. A computer collects characters from n input devices while executing a program called PROG. Every t ms, PROG calls a polling subroutine, named POLL, to check the status of all the devices sequentially. When POLL finds a character in the I/O module buffer of a device, it transfers that character to the memory and moves on to the following device. Once all the devices are checked, execution of PROG is resumed. Suppose POLL takes $(0.2+0.1*n)$ ms to poll the n devices, and each device produces r characters per second.
   (a) Express the maximum value of n as a function of t.
   (b) Express the maximum value of r as a function of t.
   (c) Express the percentage of time spent in servicing the devices as a function of n and t.
   (d) If eight input devices are connected to this computer, which conditions need to be satisfied in order to prevent any loss of characters and guarantee that no more than 10% of the computer time is consumed in servicing these devices?

5. Consider a system in which each bus cycle takes 200 ns. Transfer of bus control in either direction, from processor to I/O device or vice-versa, takes 75 ns. One of the I/O devices has a data transfer rate of 250 KB/s and employs DMA. Data are transferred one byte at a time.
   (a) Suppose the DMA is employed in a burst mode. That is, the DMA controller gains bus mastership prior to the start of a block transfer and maintains control of the bus until the whole block is transferred. For how long would the DMA controller gain mastership of the bus in order to transfer a block of 1 KB?
   (b) Repeat the calculation (from part (a)) for cycle-stealing mode.