CMP SCI 2700 – Homework 3

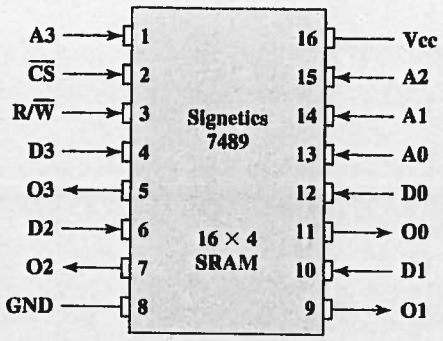
UMSL

Complete Chapter 5 End of Chapter **Problems**

- 5.10
- 5.11
- 5.12
- 5.13

Complete Chapter 6 End of Chapter **Problems**

- 6.5
- 6.7

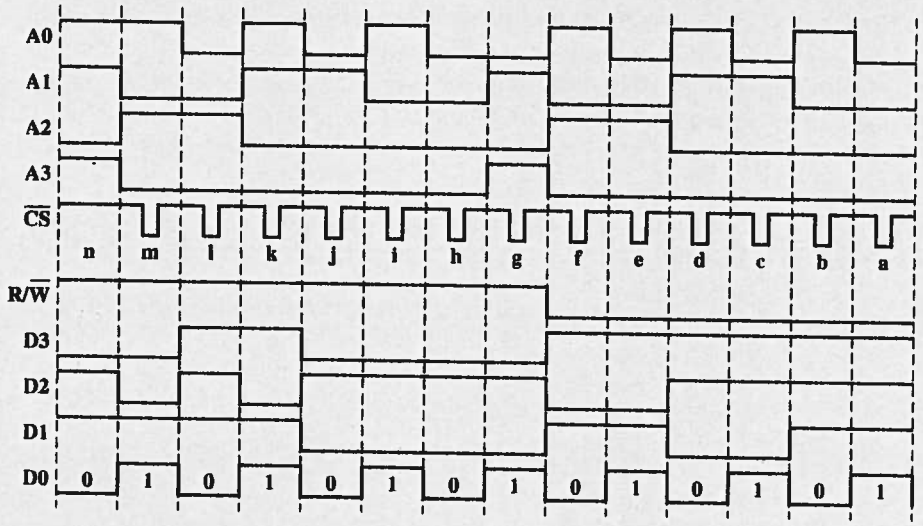



(a) Pin layout

| Operating Mode | Inputs | | | Outputs |
|---|---|---|---|---|
| | $\overline{CS}$ | R/$\overline{W}$ | D*n* | O*n* |
| Write | L | L | L | L |
| | L | L | H | H |
| Read | L | H | X | Data |
| Inhibit writing | H | L | L | H |
| | H | L | H | L |
| Store - disable outputs | H | H | X | H |

H = high voltage level
L = low voltage level
X = don't care

(b) Truth table




(c) Pulse train

**Figure 5.21** The Signetics 7489 SRAM

**5.10** For the Hamming code shown in Figure 5.10, show what happens when a check bit rather than a data bit is in error?

**5.11** Suppose an 8-bit data word stored in memory is 11000010. Using the Hamming algorithm, determine what check bits would be stored in memory with the data word. Show how you got your answer.

**5.12** For the 8-bit word 00111001, the check bits stored with it would be 0111. Suppose when the word is read from memory, the check bits are calculated to be 1101. What is the data word that was read from memory?

**5.13** How many check bits are needed if the Hamming error correction code is used to detect single bit errors in a 1024-bit data word?

**5.14** Develop an SEC code for a 16-bit data word. Generate the code for the data word 0101000000111001. Show that the code will correctly identify an error in data bit 5.

**6.4** Consider a magnetic disk drive with 8 surfaces, 512 tracks per surface, and 64 sectors per track. Sector size is 1 kB. The average seek time is 8 ms, the track-to-track access time is 1.5 ms, and the drive rotates at 3600 rpm. Successive tracks in a cylinder can be read without head movement.

**a.** What is the disk capacity?

**b.** What is the average access time? Assume this file is stored in successive sectors and tracks of successive cylinders, starting at sector 0, track 0, of cylinder *i*.

**c.** Estimate the time required to transfer a 5-MB file.

**d.** What is the burst transfer rate?

**6.5** Consider a single-platter disk with the following parameters: rotation speed: 7200 rpm; number of tracks on one side of platter: 30,000; number of sectors per track: 600; seek time: one ms for every hundred tracks traversed. Let the disk receive a request to access a random sector on a random track and assume the disk head starts at track 0.

**a.** What is the average seek time?

**b.** What is the average rotational latency?

**c.** What is the transfer time for a sector?

**d.** What is the total average time to satisfy a request?

**6.6** A distinction is made between physical records and logical records. A **logical record** is a collection of related data elements treated as a conceptual unit, independent of how or where the information is stored. A **physical record** is a contiguous area of storage space that is defined by the characteristics of the storage device and operating system. Assume a disk system in which each physical record contains thirty 120-byte logical records. Calculate how much disk space (in sectors, tracks, and surfaces) will be required to store 300,000 logical records if the disk is fixed-sector with 512 bytes/sector, with 96 sectors/track, 110 tracks per surface, and 8 usable surfaces. Ignore any file header record(s) and track indexes, and assume that records cannot span two sectors.

**6.7** Consider a disk that rotates at 3600 rpm. The seek time to move the head between adjacent tracks is 2 ms. There are 32 sectors per track, which are stored in linear order from sector 0 through sector 31. The head sees the sectors in ascending order. Assume the read/write head is positioned at the start of sector 1 on track 8. There is a main memory buffer large enough to hold an entire track. Data is transferred between disk locations by reading from the source track into the main memory buffer and then writing the data from the buffer to the target track.

**a.** How long will it take to transfer sector 1 on track 8 to sector 1 on track 9?

**b.** How long will it take to transfer all the sectors of track 8 to the corresponding sectors of track 9?

**6.8** It should be clear that disk striping can improve data transfer rate when the strip size is small compared to the I/O request size. It should also be clear that RAID 0 provides improved performance relative to a single large disk, because multiple I/O requests can be handled in parallel. However, in this latter case, is disk striping necessary? That is, does disk striping improve I/O request rate performance compared to a comparable disk array without striping?

**6.9** Consider a 4-drive, 200 GB-per-drive RAID array. What is the available data storage capacity for each of the RAID levels 0, 1, 3, 4, 5, and 6?

**6.10** For a compact disk, audio is converted to digital with 16-bit samples, and is treated a stream of 8-bit bytes for storage. One simple scheme for storing this data, called direct recording, would be to represent a 1 by a land and a 0 by a pit. Instead, each byte is expanded into a 14-bit binary number. It turns out that exactly 256 ($2^8$) of the total of 16,134 ($2^{14}$) 14-bit numbers have at least two 0s between every pair of 1s, and these are the numbers selected for the expansion from 8 to 14 bits. The optical system detects the presence of 1s by detecting a transition for pit to land or land to pit. It detects 0s by measuring the distances between intensity changes. This scheme requires that there are no 1s in succession; hence the use of the 8-to-14 code.