COE 308, Computer Architecture, Term 982
HW# 3

Due date: Saturday, March 13

Q.1.   A computer system has a main memory with an average access time of 160 ns and a cache with an average access time of 20 ns.

(i)   If a loop of instructions is stored in 15 words and the loop is repeated 50 times, what is the average access time?

(ii) Choose suitable memory interleaving (i.e., the number of interleaved memory modules) to obtain an average access time of less than 30ns, assuming that each word is accessed 2 times on average.

Q.2.   A computer system has three levels of memory, a cache memory with access time of 20 ns, a semiconductor main memory with access time of 200 ns, and a magnetic disk secondary memory with access time of 2 ms.

(i)   Assuming a main memory hit ratio of 80%, what is the minimum cache hit ratio for an average access time of 100ns.

(ii)   Assuming a cache memory hit ratio of 80%, what is the minimum main memory hit ratio for an average access time of 100ns.

Q.3.   A computer employs a 32 Mbyte 32-bit word main memory and a cache of 4 Kbytes. Determine the number of bits in each field of the address in the following organizations:

(i)   Direct mapping with a line size of 4 words

(ii) Four-way set associative mapping with a line size of one word.

Q.4.   Design the logic to implement the least recently used replacement algorithm for four lines using the reference matrix method.

Q.5.   Assume that a computer system has a cache with only four lines and requests to access the following sequence of addresses:
               1 7 6 4 1 6 5 1 6 7 1 4 2
Show the implementation of the least recently used algorithm for the above sequence using the following methods:

(i)   Counter method.

(ii) Reference matrix method.

(iii) Binary tree approximate method.