King Fahd University of Petroleum and Minerals
College of Computer Sciences and Engineering
Department of Computer Engineering

COE 308 – Computer Architecture (T041)

Homework # 02 (*due date: Sunday 31/10/2004*)

***** Show all your work. No credit will be given if work is not shown! *****

Problem # 1 (10 points): Consider a computer system that has a cache consisting of 64 blocks. The MM contains 512K blocks, each consisting of 16 words. Answer the following assuming (i) fully associative cache, (ii) direct cache, then (iii) set associative with sixteen-block sets:

1. How many bits are needed for the MM address?
2. How many bits are needed for each of the TAG, SET, and WORD fields?

Problem # 2 (5 points): Solve problem 3.5 from the textbook.

Problem # 3 (10 points): Solve problem 3.14 from the textbook.

Problem # 4 (10 points): Solve problem 3.15 from the textbook.

Problem # 5 (20 points): Consider a 4×8 array of numbers, A. Assume that each number in the array occupies one word in MM and that the array elements are stored **column-major** in MM starting from location 1008 to location 1039. The cache consists of 8 blocks each consisting of just two words. The cache is initially empty. Assume also that whenever needed, LRU replacement policy is used. Analyze the cache for the following segment of a program:

```
sum = 0;
For i = 0 to 1
        For j = 0 to 7
                sum = sum + A(i, j)
        EndFor
EndFor
```

Fill out the following assuming (i) direct mapping, then (ii) fully associative mapping. Also, calculate the hit ratio, the number of block replacements, and the percentage of cache utilization in each case.

Request	Cache Hit/Miss	MM Address	Cache Block number	Cache Content							
				B0	B1	B2	B3	B4	B5	B6	B7
A(0, 0)											
A(0, 1)											
A(0, 2)											
A(0, 3)											
A(0, 4)											
A(0, 5)											
A(0, 6)											
A(0, 7)											
A(1, 0)											
A(1, 1)											
A(1, 2)											
A(1, 3)											
A(1, 4)											
A(1, 5)											
A(1, 6)											
A(1, 7)											