**I)**

Show how 32-bit addresses are divided into tag, index, and offset given the following cache descriptions:

1) 8KB, byte addressable, 4-way set associative cache with 4 byte blocks
2) 16KB, byte addressable, 8-way set associative cache with 2 byte blocks.
3) 32 KB fully associative cache with 128 byte blocks

1)

```
addressable (K_byte): 8
way : 4
blocks : 4
line 9     offset 2   tag 21
```

```
2)
addressable (K_byte): 16
way : 8
blocks : 2
line 10    offset 1   tag 21
```

```
3)
addressable (K_byte): 32
blocks : 128
line 8
offset 7
tag 25
```

**II)**

Consider a 2-way set associative cache with 64 blocks and a block size of 16 bytes. To which set number does byte address 1200 map?

Block address memory = 1200/16 = 75
Block address cache = 75mod(64) = 11

**III)**

**4)** A computer system uses 16-bit memory addresses. It has a 2K-byte cache organized as a 2-way set-associative cache that uses the LRU replacement algorithm with 64 bytes per cache block. Assume that the size of each memory word is 1 byte.

(a) Calculate the number of bits in each of the Tag, Block, and Word fields of the memory address.

64 bytes = 2(6) bytes = 2(6) words
**Word 6**
2K-byte = 2(11) bytes
2(11)/2(6) = 2(5)
**Block 5**
16 - 6 - 5 = 5
**Tag 5**

**(b)** When a program is executed, the processor reads data sequentially from the following word addresses: 128, 144, 2176, 2180, 128, 2176. All the above addresses are shown in decimal values. Assume that the cache is initially empty. For each of the above addresses, indicate whether the cache access will result in a hit or a miss.

(128)10 = (0000000010000000)2
Tag = 00000, Block = 00010, Word = 000000 miss
Block1 0010 - 000000

(144)10 = (0000000010010000)2
Tag = 00000, Block = 00010, Word = 010000 hit

(2176)10 = (0000100010000000)2
Tag = 00001, Block = 00010, Word = 000000 miss
Block2 00001 - 000000

(2180)10 = (0000100010000100)2
Tag = 00001, Block = 00010, Word = 000100 hit

(128)10 = (0000000010000000)2
Tag = 00000, Block = 00010, Word = 000000 hit

(2176)10 = (0000100010000000)2
Tag = 00001, Block = 00010, Word = 000000 hit