Direct-mapped cache.

I)

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

a) 32KB, byte addressable, 8-way set associative cache with4 byte blocks

b) 16KB, byte addressable, direct mapped cache with 8 byte blocks

16KB = 2^4*2^10=2^14 Byte
lines = 2^14/2^3=2^11 --→ 11bites
offset = 2^3 -→ 3 bites
tag = 32-11-3=18 bites

c) 64KB fully associative cache with 64 byte blocks
64KB = 2^6*2^10=2^16
Offset=2^6 -→6 bites
Tag=32-6=26 bits

II)

Consider a direct-mapped cache with 64 blocks and a block size of 16 bytes. To what block number does byte address 1200 map?(7 ppt)

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

III)

Assume a computer has 32 bit addresses. Each block stores 16 words. A direct-mapped cache has 256 blocks. In which block (line) of the cache would we look for each of the following addresses? Addresses are given in hexadecimal for convenience.

a. 1A2BC012
0001 1010 0010 1011 1100 **0000 0001** 0010
0001 1010 0010 1011 1100 -teg
01 →1 block

0010→word

b. FFFF00FF
1111 1111 1111 1111 0000 **0000 1111** 1111
1111 1111 1111 1111 0000→teg
0F -→15 →block
1111→word

c. 12345678
0001 0010 0011 0100 0101 **0110 0111** 1000
0001 0010 0011 0100 0101-→teg

67--→103→block
1000→word

d. C109D532
1100 0001 0000 1001 1101 **0101 0011** 0010
1100 0001 0000 1001 1101→ teg
53 -→83→block
0010→word

IV)

A computer system uses 16-bit memory addresses. It has a 2K-byte cache organized in a direct-mapped manner 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.

Word=(64) 2^6 →6
2K =2* 2^10=2^11(total size)
Line =2^11/2^6 = 2^5
Tag = 16-5-6=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.

Address = (128)10 = (00000-tag00010-block 000000-word)2
Tag field for cache block 00010 is set to 00000

144=0000 0 -tag 000 10-block 01 0000word -hit

2176
Address = (2176)10 = (0000100010000000)2
Tag = 00001, Block = 00010, Word = 000000
ag field for cache block 00010 is set to 00001-miss
2180
Address = (2176)10 = (0000100010000000)2
Tag = 00001, Block = 00010, Word = 000000
Tag field for cache block 00010 is set to 00001-hit

Address = (128)10 = (00000-tag00010-block 000000-word)2
Tag field for cache block 00010 is set to 00000-miss

Tag = 00001, Block = 00010, Word = 000000
ag field for cache block 00010 is set to 00001-miss

2/6=0.33