Example (1) : Consider direct mapped cache of size 16 KB with block size 256 bytes. The size of main memory is 128 KB. Find
1) P.A bit split
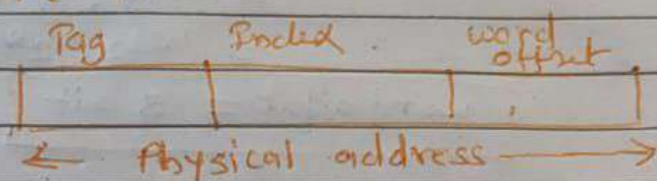2) Tag directory size

Sol^n :-

Given

Cache memory size = 16 kB

Block size = 256 bytes

main memory size = 128 kB

find : (1)

Tag	Block	word offset

$\xleftarrow{}$ Physical address $\xrightarrow{}$

Step 1 :- Number of bits in physical address

$$P.A = \log_2 (\text{size of M.M})$$

$$= \log_2 (128 \text{ kB})$$

$$= \log_2 (2^7 \times 2^{10})$$

$$= \log_2 (2^{17})$$

$$\boxed{P.A = 17 \text{ bit}}$$

Step 2 : Number of a cache line

$$= (\text{size of C.M}) / (\text{Block size})$$

$$= 16 kB / 256$$

$$= 2^4 \cdot 2^{10} / 2^8$$

$$= 2^{14} / 2^8$$

$$\boxed{\text{No. of cache line} = 2^6}$$

Step 3: No. of M.M. block

$$= (\text{size of M.M.}) / (\text{Block size})$$

$$= \frac{128 \text{ kB}}{256 \text{ Bytes}}$$

$$= (2^7 \cdot 2^{10}) / (2^8)$$

$$= 2^{17}/2^8$$

No. of M.M. block $= 2^9$

step 4:

$$\text{word offset} = \log_2 (\text{Block size})$$

$$= \log_2 (256 \text{ bytes})$$

$$= \log_2 (2^8)$$

word offset $= 8$ bit

Step 5:

$$\text{Index} = \log_2 (\text{No. of. cache lines})$$

$$= \log_2 (2^6)$$

Index $= 6$ bit

Step 6:

$$\text{tag} = \text{P.A bit} - \text{Index bit} - \text{word offset bit}$$

$$= 17 - 8 - 6$$

tag $= 3$ bit

OR

$$\text{tag} = \log_2 \left(\frac{\text{No. of block in M.M}}{\text{No. of cache lines}} \right)$$

$$= \log_2 \left(2^9 / 2^6 \right)$$

tag $= 3$ bit

3	6	8

$\xleftarrow{\hspace{1cm}}$ 17 -bit $\xrightarrow{\hspace{1cm}}$

Step 7:

Tag directory size = No. of lines in
                    Cache * No. of bits
                              in tag.

$$= 2^6 \times 3$$

$$= 64 \times 3$$

$$= 192 \text{ bits}$$