Solution 4

1.

(a) Direct-mapped: 3-bit **Block = $A_{5\text{-}3}$**, 1-bit **Word = A_2**; miss rate = 6/10.

Tag	Word 1	Word 0	
			Block 0
001000	[20C]	[208]	Block 1
000010	[094]	[090]	Block 2
001001	[25C]	[258]	Block 3
			Block 4
			Block 5
			Block 6
			Block 7

(b) 2-way set-associative: 2-bit **Set = $A_{4\text{-}3}$**, 1-bit **Word = A_2**; miss rate = 5/10.

Tag	Word 1	Word 0	
			Set 0
			Set 0
0010000	[20C]	[208]	Set 1
			Set 1
0000100	[094]	[090]	Set 2
0010010	[254]	[250]	Set 2
0000100	[09C]	[098]	Set 3
0010010	[25C]	[258]	Set 3

(c) Fully associative: 1-bit **Word = A_2**; miss rate = 5/10.

Tag	Word 1	Word 0
000010011	[09C]	[098]
000010010	[094]	[090]
001001010	[254]	[250]
001000001	[20C]	[208]
001001011	[25C]	[258]

2.

(a) Direct-mapped: 2-bit **Block = $A_{6\text{-}5}$**, 3-bit **Word = $A_{4\text{-}2}$**; miss rate = 5/10.

Tag	Word 7	Word 6	Word 5	Word 4	Word 3	Word 2	Word 1	Word 0	
00001	[09C]	[098]	[094]	[090]	[08C]	[088]	[084]	[080]	Block 0
00100	[23C]	[238]	[234]	[230]	[22C]	[228]	[224]	[220]	Block 1
00100	[25C]	[258]	[254]	[250]	[24C]	[248]	[244]	[240]	Block 2
									Block 3

(b) 4-way set-associative: 1-bit **Set = A_5**, 3-bit **Word = $A_{4\text{-}2}$**; miss rate = 5/10.

Tag	Word 7	Word 6	Word 5	Word 4	Word 3	Word 2	Word 1	Word 0	
001000	[21C]	[218]	[214]	[210]	[20C]	[208]	[204]	[200]	Set 0
000010	[09C]	[098]	[094]	[090]	[08C]	[088]	[084]	[080]	Set 0
001000	[23C]	[238]	[234]	[230]	[22C]	[228]	[224]	[220]	Set 1
									Set 1

(c) Fully associative: 3-bit **Word = $A_{4\text{-}2}$**; miss rate = 4/10.

Tag	Word 7	Word 6	Word 5	Word 4	Word 3	Word 2	Word 1	Word 0
0000100	[09C]	[098]	[094]	[090]	[08C]	[088]	[084]	[080]
0010010	[25C]	[258]	[254]	[250]	[24C]	[248]	[244]	[240]
0010000	[21C]	[218]	[214]	[210]	[20C]	[208]	[204]	[200]
0010001	[23C]	[238]	[234]	[230]	[22C]	[228]	[224]	[220]

3.

$$T_{ave} = h_1 C_1 + (1-h_1)h_2 C_2 + (1-h_1)(1-h_2)M = 7.2\tau - 4.8h_2.$$

If $h_2 = 1$ (i.e., 100% hit rate), then $T_{ave} = 2.4\tau$ (minimum).

If $T_{ave} = 4\tau$, then $h_2 = 2/3$ (i.e., 67% hit rate).