Solution 4

1.

(a) Direct-mapped: 3-bit **Block = A_{6-4}**, 2-bit **Word = A_{3-2}**; miss rate = 7/10.

Tag	Word 3	Word 2	Word 1	Word 0	
					Block 0
					Block 1
					Block 2
00000	[03C]	[038]	[034]	[030]	Block 3
					Block 4
00000	[05C]	[058]	[054]	[050]	Block 5
					Block 6
00000	[07C]	[078]	[074]	[070]	Block 7

(b) 2-way set-associative: 2-bit **Set = A_{5-4}**, 2-bit **Word = A_{3-2}**; miss rate = 8/10.

Tag	Word 3	Word 2	Word 1	Word 0	
					Set 0
					Set 0
000001	[05C]	[058]	[054]	[050]	Set 1
					Set 1
					Set 2
					Set 2
000001	[07C]	[078]	[074]	[070]	Set 3
000000	[03C]	[038]	[034]	[030]	Set 3

(c) 4-way set-associative: 1-bit **Set = A_4**, 2-bit **Word = A_{3-2}**; miss rate = 6/10.

Tag	Word 3	Word 2	Word 1	Word 0	
					Set 0
					Set 0
					Set 0
					Set 0
0000111	[0FC]	[0F8]	[0F4]	[0F0]	Set 1
1111111	[FFC]	[FF8]	[FF4]	[FF0]	Set 1
0000001	[03C]	[038]	[034]	[030]	Set 1
0000011	[07C]	[078]	[074]	[070]	Set 1

2.

(a) Direct-mapped: 3-bit **Block = A_{5-3}**, 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_{4-3}**, 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]

3.

$T_{ave} = h_1C_1 + (1-h_1)h_2C_2 + (1-h_1)(1-h_2)M = 5.0\tau - 2.4\tau\, h_2$.

If **$T_{ave} = 3\tau$**, then **$h_2 \approx 83\%$**.