

Name: Solution

Lab Section: _____

Problem 1 (3 points)

- (a) Add in binary (b) Subtract using 2's complement (with addition) (c) Multiply in binary

$$\begin{array}{r} 01001 \\ + 00111 \\ \hline 10000 \end{array}$$

$$\begin{array}{r} 01010 \\ - 00101 \\ \hline \end{array}$$

$$\begin{array}{r} 01010 \\ + 11010 \\ \hline 00101 \end{array}$$

$$\begin{array}{r} 01101 \\ \times 00011 \\ \hline \end{array}$$

$$\begin{array}{r} 01101 \\ 01101 \\ 00000 \\ 00000 \\ 00000 \\ \hline 00010011 \end{array}$$

Problem 2 (3 points) Find the minimum sum of products for Z from the following Karnaugh Map.

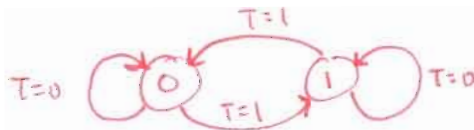
CD \ AB				
	00	01	11	10
00	1	0	0	1
01	0	0	0	0
11	0	1	1	0
10	1	0	0	1

Z

$$Z = \overline{B} \cdot \overline{D} + A \cdot B \cdot D$$

Problem 3 (4 points) Draw the Moore state transition graph corresponding to a toggle (T) flip-flop. Write the next state equation. Implement it using a single D-FlipFlop and logic gates.

Toggle Flip-Flop: $T=0 \Rightarrow Q^+ = Q$
 $T=1 \Rightarrow Q^+ = \overline{Q}$



Present State	Next State		output
	T=0	T=1	
0	0	1	0
1	1	0	1

T	0	1
	0	1
1	1	0

$$Q^+ = T \oplus Q$$

