Solutions to Assignment 8.

1.A. Let Priority A be represented by 0, and Priority B by 1.

The next state table:

Q	R_A	R_B	Q^+	G_A	G_B
0	0	0	1	0	0
0	0	1	1	0	1
0	1	0	0	1	0
0	1	1	0	1	0
1	0	0	0	0	0
1	0	1	1	0	1
1	1	0	0	1	0
1	1	1	1	0	1

Q^+:

$Q \backslash R_A R_B$	00	01	11	10
0	1	1		
1		1	1	

$$Q^+ = \bar{Q}\bar{R}_A + Q R_B = \overline{Q + R_A} + Q R_B$$

G_A:

$Q \backslash R_A R_B$	00	01	11	10
0			1	1
1				1

G_B:

$Q \backslash R_A R_B$	00	01	11	10
0		1		
1		1	1	

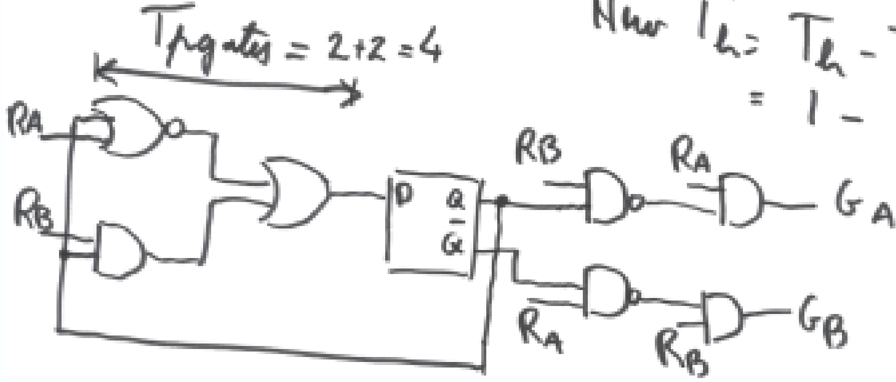
$$G_B = \bar{R}_A R_B + Q R_B = R_B\,\overline{\bar{Q} R_A}$$

$$G_A = \bar{Q} R_A + R_A \bar{R}_B = R_A\left(\overline{Q R_B}\right)$$

The diagram:

New $T_{su} = T_{su} + T_{pgates} = 2 + 4$
$= 6$

New $T_h = T_h - T_{pgates}$
$= 1 - 4 = -3$



B. See attached paper for timing diagram.

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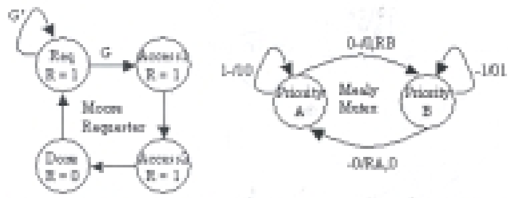
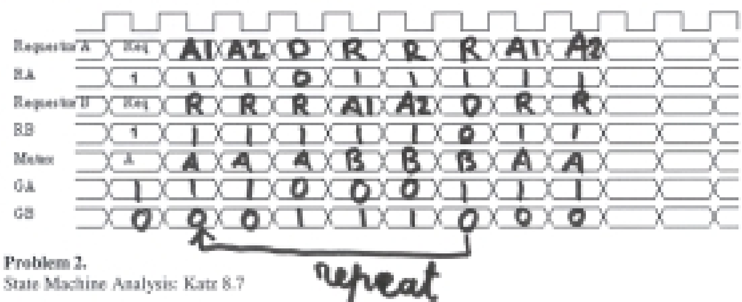
Reading: Katz 8 except 8.3, 9 except 9.3.4, 10.2, and 11 for reference.

Problem 1.
Moore v Mealy, Communicating State Machines:



Part A. Complete the design of the Mealy Mutex state machine above using D-flip-flops. If Tsu = 2ns and Th = 1ns for the D-ff, what are the setup and hold times for RA and RB?

Part B. Without considering detailed timing issues, draw the timing diagram for a system consisting of two instances of the Moore Requester and one Mealy Mutex. Your timing diagram should show all of the signal values, and the states of all three machines. The initial states are shown. What is the utilization of the hypothetical resource (Access Cycles/Total Cycles).?



Problem 2.
State Machine Analysis: Katz 8.7

Problem 3.
State Minimization: Katz 9.5

6 cycles out of which the resources is used in 4 cycles => utilization $= \frac{4}{6} = \frac{2}{3}$

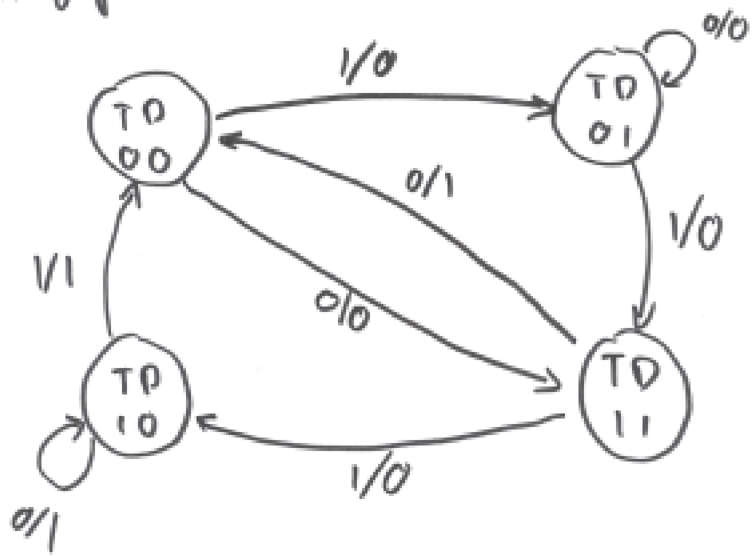
2. Note: $D^+ = \overline{T}$ $\qquad Z = (\overline{DI})\,T$

$T^+ = I \text{ XNOR } D$

Also Note that $A \text{ XNOR } 0 = \overline{A}$

and $A \text{ XNOR } 1 = A$

So, simply draw the four states, and then figure out the arrows:



3. Next state table:

Current	Next $X=0$	Next $X=1$	Output
S_0	S_5	S_2	0
S_1	S_0	S_1	1
S_2	S_0	S_5	1
S_3	S_3	S_1	1
S_4	S_0	S_5	1
S_5	S_0	S_5	1
S_6	S_5	S_4	0

S_1	X					
S_2	X	S_0-S_0 S_1-S_5				
S_3	X	$\cancel{S_0-S_3}$ $\cancel{S_1-S_1}$	$\cancel{S_0-S_3}$ $\cancel{S_1-S_5}$			
S_4	X	S_0-S_0 S_5-S_5	S_0-S_0 S_5-S_5	$\cancel{S_0-S_3}$ $\cancel{S_1-S_5}$		
S_5	X	S_0-S_0 S_1-S_5	S_0-S_0 S_5-S_5	$\cancel{S_0-S_3}$ $\cancel{S_1-S_5}$	S_0-S_0 S_5-S_5	
S_6	S_5-S_5 S_2-S_4	X	X	X	X	X
	S_0	S_1	S_2	S_3	S_4	S_5

Thus, equivalent states are:

$$S_0 = S_6$$
$$S_1 = S_2 = S_4 = S_5$$

Let $S_{1245} = S_1 = S_2 = S_4 = S_5$

$S_{06} = S_0 = S_6$

The new state diagram: