ECE 441 Assignment 3

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1. $T_{setup} = 1.0ns$, $f_{clk} = 50MHz$ · $w = 0.1ns$ $\tau = 0.5ns$ $f_d = 0.1 f_{clk}$

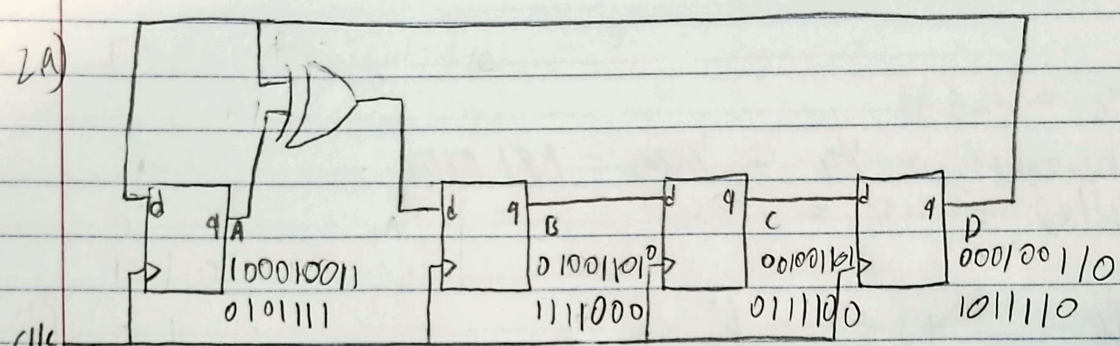
$T_r = T_c - T_{setup}$

$= \frac{1}{50MHz} - 1.0ns = 19ns$

$MTBF(T_r) = e^{(19/0.5)} / (0.1\times10^{-9})(50\times10^{6})(0.1\times50\times10^{6}) = 1.27\times10^{12}$ sec

$= 1.274$ Tera seconds

2a)



a) 1000 → 0100 → 0010 → 0001 → 1100 → 0110 → 0011 → 1101 → 1010 → 0101 → 1110 → 0111 → 1111 → 1011 → 1001 → 1000

b) The result is always 0000 because there is no 1's to change the stage

c) $2^8 - 1 = 255$ state

d) $2^{64} - 1$ state

3 $T_C = \frac{T_{comb}}{\#\,stage} + T_{cq} + T_{setup}$

Throughput $= 1/T_C$

Delay $= \#\,stage \cdot T_C$

a) $T_C = 128\,ns$

Throughput $= 1/T_C = 1/128ns = 7.81\,MHz$

Delay $= 1 \cdot T_C = 128\,ns$

b) $T_C = \frac{128}{2} + 3 + 1 = 68\,ns$

Throughput $= 1/68ns = 14.7\,MHz$

Delay $= 2 \cdot T_C = 136\,ns$

d) $T_C = \frac{128}{8} + 3 + 1 = 20ns$

Throughput $= 1/20ns = 50\,MHz$

Delay $= 8 \cdot T_C = 160\,ns$

f) $T_C = \frac{128}{32} + 3 + 1 = 8\,ns$

Throughput $= 1/8ns = 125\,MHz$

Delay $= 32 \cdot T_C = 8 \cdot 32 = 256\,ns$