# CMSC 313 Spring 2024
# Quiz 3 Answers

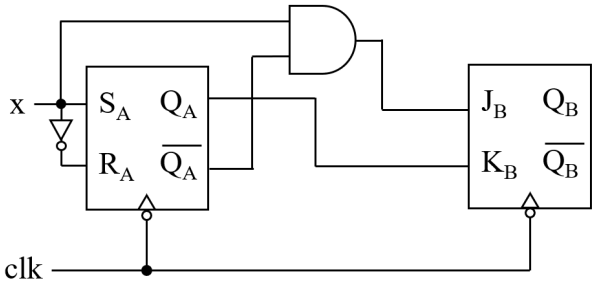
Full Name _____ Student ID _____

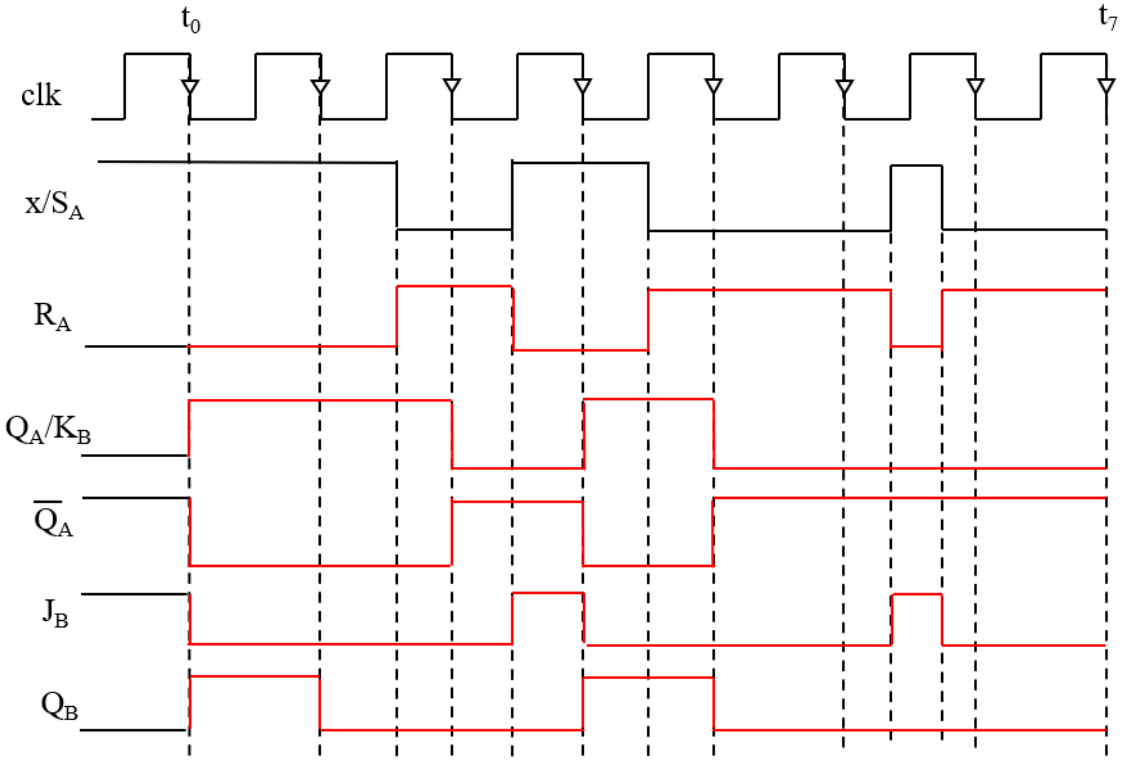
For every exercise, show your work. Not showing complete work may result in penalties.

**Exercise 1.** (10 pts) Draw the traces for the following circuit. Before $t_0$,

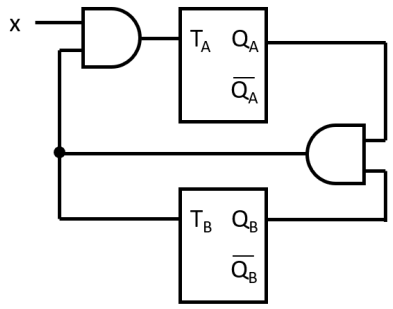
$$x = 1, Q_A = 0, J_B = 1, Q_B = 0$$

.



**Exercise 2.** Given the circuit:




a. (10 pts) Find the state equations $Q_A(t+1)$ and $Q_B(t+1)$ in terms of $x$, $Q_A(t)$, $Q_B(t)$. Box your final answer.

Step 1

$T_A = xQ_A(t)Q_B(t)$

$T_B = Q_A(t)Q_B(t)$

Step 2

$Q_A(t+1) = T\overline{Q_A(t)} + \bar{T}Q_A(t) = T \oplus Q_A(t)$

$Q_B(t+1) = T\overline{Q_B(t)} + \bar{T}Q_B(t) = T \oplus Q_B(t)$

Step 3 (I said they did not have to simplify)

For solutions with $\oplus$ they need to group operands with parenthesis.

$$Q_A(t+1)$$
$$= \overline{xQ_A(t)Q_B(t)}\,\overline{Q_A(t)} + \overline{xQ_A(t)Q_B(t)}\,Q_A(t)$$
$$= \overline{xQ_A(t)Q_B(t)}\,Q_A(t)$$
$$= \left(xQ_A(t)Q_B(t)\right) \oplus Q_A(t)$$

Any of these solutions are valid

Must use parenthesis with $\oplus$

$$Q_B(t+1)$$
$$= Q_A(t)Q_B(t)\,\overline{Q_B(t)} + \overline{Q_A(t)Q_B(t)}\,Q_B(t)$$
$$= \overline{Q_A(t)Q_B(t)}\,Q_B(t)$$
$$= \left(Q_A(t)Q_B(t)\right) \oplus Q_B(t)$$

Any of these solutions are valid

Must use parenthesis with $\oplus$

b. Complete the state table (10 pts) and complete the state diagram (10 pts).

| x | $Q_A$ | $Q_B$ | $Q_A$+ | $Q_B$+ |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 |