

EECE 2160 – Embedded Design: Enabling Robotics

Homework #3

Assigned: Sat., Oct. 12, 2024. Due Sun., Oct. 20, at 11:59pm on Canvas

5 Problems 100 points total

Show your work!

Problem 1. (30 points, 10 points each)

Design a circuit that will tell whether a given month has 31 days in it. The month is specified by a 4-bit input $A_{3:0}$. For example, if the inputs are 0001, the month is January, if the inputs are 1100 the month is December. The circuit output Y should be HIGH only when the month specified by the inputs has 31 days in it.

- Draw the truth table
- Draw the simplified equation
- Draw the circuit diagram using the simplified equation

Hints:

Use a Karnaugh Map for simplification

Take advantage of “don’t cares,” see lecture 4 slide 32 – 34.

Problem 2. (20 points, 10 points each)

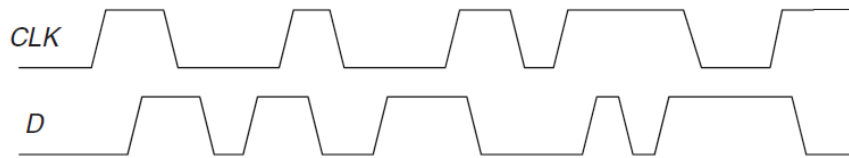
Design 4-bit left and right rotators. There should be a 2-bit input named *roamt* that determines how many bits to rotate.

- a. 4-bit left rotator: sketch a schematic of your design
- b. 4-bit right rotator: sketch a schematic of your design

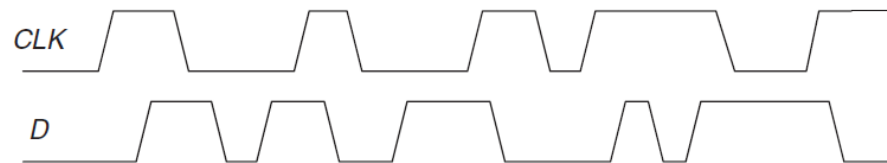
Hint: look at design of left and right shifters

Problem 3. (10 points total, 5 points each)

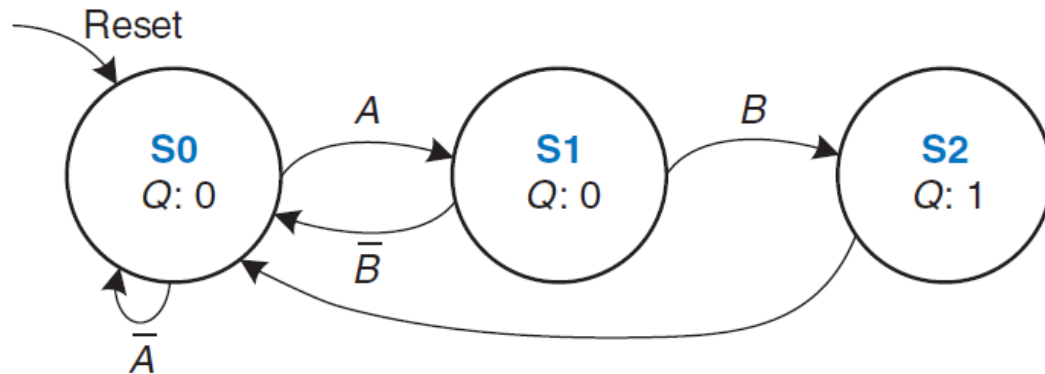
- a. For the following waveforms, sketch the output Q of a D-Latch:



- b. For the following waveforms, sketch the output Q of a D-Flip-Flop



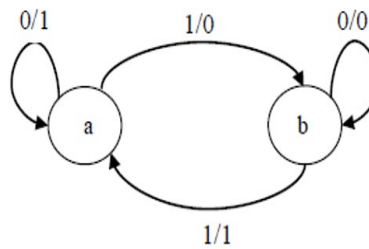
Problem 4. (20 points) Consider this Moore-type Finite State Machine represented by the state transition diagram below.



Use binary encodings

- (8 points) Write the following:
 - State encoding table
 - State transition table (using state and input encodings)
- (2 points) Write the output table (using state and output encodings)
- (2 points) Write Boolean equations for (simplification optional):
 - The next state logic
 - The output logic
- (8 points) Sketch a schematic (circuit diagram) of the Finite State Machine.

Problem 5. (20 points total, 10 points each) Design a sequential logic circuit to implement the following state diagram of a Mealy-type Finite State Machine.



- a. Fill-in the state table (table has more rows than needed)

Current State	Input	Next State	Output
Q	X	Q*	Y

- b. Draw the schematic diagram of the circuit.