ET401 – Quiz 1  
Fall 2018

In giving your answer, the answer alone is not enough. Good engineering practice requires that you clearly give your rationale for arriving at your answer. Your pathway to your solution must be checkable.

Problem values: 1,4: 5 pts; 2,3: 10 pts; 5,6: 15 pts; 7:40 pts

1. Fill in the truth table below:

<table>
<thead>
<tr>
<th>I1</th>
<th>I2</th>
<th>OR</th>
<th>NOR</th>
<th>AND</th>
<th>NAND</th>
<th>XOR</th>
<th>NXOR</th>
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2. Use a single rung to write the logic that instantiates a NAND.

3. Use two rungs to create a NAND from an AND.
4. Rewrite the ladder program below to improve it.

```
I1       ( )
        I2

( )
I2       O1
```

5. Identify the things wrong with the ladder-logic diagram and system shown below by marking the drawing up. Include both things that are operationally wrong but also format items that should be corrected to comply with the good practice for drawing ladders that we have worked out in class.

![Ladder Logic Diagram](image)

6. Fill in the table we used in Lab 1.

<table>
<thead>
<tr>
<th>UNACT/ACT</th>
<th>NO/NC</th>
<th>V (+/0)</th>
<th>MAKE/BREAK</th>
<th>UNMADE/MADE or UNBRKN/BRKN</th>
<th>OUT (OFF/ON)</th>
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2 of 4
7. An airliner, when it takes off, needs to have its flaps deployed into take-off position. If it doesn’t the plane won’t develop enough lift on the take-off roll to take off. Once the plane is off the ground at a certain altitude and at a certain speed, the flaps can be retracted for the climb-out. There have actually been crashes due to not deploying the flaps prior to going to full thrust.

Let’s automate this procedure for the pilot. Let’s have a DPLY button (momentary, NO pushbutton) to deploy the flaps (FLPS) and keep deploying them until a DPLYD sensor verifies that they are out (it goes high). The pilot should just have to push the DPLY button once, i.e. not hold his finger on it. After the FLPS are DPLYD, the pilot pushes a THRST button (momentary, NO pushbutton) to go to max power for take-off (PWR). The system stays at max PWR even when the pilot stops pushing the THRST button. Since at this point the airplane is in automated take-off (ATO) mode, an indicator light, ATO is illuminated. Two other sensors are needed, a speed sensor (SPD) to verify that the plane has reached flap-retract speed and an altitude sensor (ALT) to indicate that the plane has reached a safe altitude for flap retraction. Once both of these sensors go high, ATO ends and a retract actuator (RTRCT) is activated to draw the flaps back in. There is a position sensor (RTRCTD) that turns RTRCT off when it goes high. PWR is also shut off, which means that the engines do not have to be at full thrust.

Answer the following questions about this system:

a. Of the inputs and outputs given (DPLY, FLPS, DPLYD, THRST, PWR, ATO, SPD, ALT, RTRCT, RTRCTD), which are inputs?

b. Which of these are outputs?

c. Draw a rung that deploys the flaps with the momentary, NO pushbutton DPLY as described above.

d. With the FLPS DPLYD, the pilot pushes the THRST pushbutton. Draw a rung that puts the engines at PWR and holds them there, but only if the flaps are deployed. With PWR on, automated take-off mode has been entered. Draw a second rung that turns on the ATO light when automated take-off mode has been entered.
e. Draw a rung that, with ATO mode active, detects when the needed speed and altitude have been reached, and when this occurs, turns PWR off. This should also turn off the ATO mode and indicator light.

f. Draw a rung that retracts the flaps automatically (activates RTRCT) when the speed sensor is high and the altitude sensor is high. RTRCT stays active until RTRCTD becomes high.

g. Modify the rung in part c so that it the DPLY button is overridden (does not work) if the speed sensor is high. You can tear the flaps off of a plane if you deploy them at too great a speed.
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Problem values: 1,5,6: 13 pts; 2: 10 pts; 3: 6 pts; 4: 5 pts; 7: 40 pts

1. Fill in the truth table below for the three rungs shown.

2. Rewrite any rungs in the ladder above to simplify that can be simplified and still give the same result.
3. Circle one next to each statement:
   T     F     An actuated NC with a MAKE allows logic to pass.
   T     F     An unactuated NO with a BREAK allows logic to pass.
   T     F     An unactuated NO with a MAKE allows logic to pass.
   T     F     An actuated NO with a BREAK allows logic to pass.

4. Draw the flip-flop rung that we saw in lab, the one that kept turning ON and OFF. No need to draw the external hardware.

5. In the space below, draw a standard control loop with all components, the signals properly signed that go into summing junctions, the loop input and output labels labelled meaningfully.

6. Draw a PMP starting circuit that uses a momentary NO pushbutton to STRT it and a momentary NC pushbutton to STP it. Draw also the buttons, then the PMP and two indicator lights RED and GRN to indicate that the PMP is OFF or ON, respectively.
7. An airliner, when it takes off, needs to have its flaps deployed into take-off position. If it doesn't the plane won't develop enough lift on the take-off roll to take off. Once the plane is off the ground at a certain altitude and at a certain speed, the flaps can be retracted for the climb-out. There have actually been crashes due to not deploying the flaps prior to going to full thrust.

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