

EE 476 Exam I

Spring 2014

Instructions You have 50 minutes to complete this exam. You are not allowed the use of any reference materials or electronic devices. Point values are given for each question. Ask your instructor for clarification if any question is not clear.

Question 1. (10 points) Write ladder logic that will turn on a fan whenever the temperature of a piece of equipment reaches 40°C or above, and keep it on until the temperature is 5°C below the turn-on temperature. Also, activate a warning light if the temperature stays above 40°C for more than 30 seconds.

Question 2. (20 points) As part of your laboratory work you needed to decide if a part was properly assembled or not, and either reject or let it pass. Discuss and clearly explain your thinking and approach, e.g. did you use timers? Shift registers? How so? Why? Be as thorough as you can. You do not need to reproduce your ladder logic or any ladder logic unless you feel it aids your explanation.

Question 3. (20 points) You are assigned to design ladder logic to ensure proper operation of a washer manufacturing process by catching production errors and sorting the parts appropriately. You will be looking at the point after holes are punched through metal discs to catch two main issues:

1. The disc was able to pass through the punching area without a hole being made.
2. A hole is successfully made but the resulting washer is warped beyond a specified tolerance or the hole was off-center.

You have a total of 5 sensors and 2 actuators at your disposal:

I:0 *Hole Sensor* - Optical sensor capable of detecting the presence of a properly centered hole. This sensor will be active when it sees an exactly centered hole and will be inactive otherwise.

I:1 *Weight Sensor* - Mechanical sensor capable of very precisely measuring the weight of the part. This sensor will be active if it encounters a part with weight above a certain tolerance and inactive otherwise.

I:2 *Warp Sensor* - Optical sensor capable of determining whether or not the part is sufficiently flat or not. This sensor is active if it spots an error and inactive otherwise.

I:3 *Sort Sensor A* - Optical sensor capable of detecting the presence of an object in front of Reject Solenoid A. It will be active if an object is seen and inactive otherwise.

I:4 *Sort Sensor B* - Optical sensor capable of detecting the presence of an object in front of Reject Solenoid B. It will be active if an object is seen and inactive otherwise.

O:0 *Sort Solenoid A* - Solenoid capable of pushing parts into Reject Bin A.

O:1 *Sort Solenoid B* - Solenoid capable of pushing parts into Reject Bin B.

Reject Bin A will simply be sent back through the punch machine, while Reject Bin B will be melted down for complete reprocessing.

Write ladder logic that will intelligently sort any problematic parts into an appropriate bin and allow good parts to pass. For simplicity, assume that things are spaced so that you can deal with one part at a time.