Department of Electrical and Computer Engineering
University of Massachusetts Dartmouth

ECE544 Fault-Tolerant Computing & Reliability Engineering

Fall 2022

Homework #1

Name: _____

Instructor: Prof. Liudong Xing

ECE544: Fault-Tolerant Computing & Reliability Engineering
(Fall 2022)
Homework #1

Assigned: September 14, Wednesday
Due: **September 21, Wednesday, 3:30pm**

Instructions:

1. Please type your answers or write your answers clearly (illegible writing will NOT be graded).
2. Please organize all pages of your answers into **one file**, name your file using "HW1-your last name.pdf or doc" (e.g., HW1-Xing.pdf), and submit it to lxing@umassd.edu electronically or submit a hard copy on the due date.

Problems:

1. Some systems are designed for reliability, some are designed for availability, and others are designed for safety. Based on your understanding of the three concepts explained in Lecture#1 and their difference, give an example of an application requiring high reliability, one requiring high availability, and one requiring high safety. Please justify your answer.

2. Devise an original example (different from the two examples presented in Lecture#2) to illustrate the difference between faults, errors, and failures. As you illustrate these concepts, relate them to the three-universe model.

3. The company that you work for is designing an industrial controller that maintains the temperature of a fluid during a chemical reaction. The non-redundant controller (Figure 1) contains: (1) a temperature sensor; (2) analog circuitry to process the temperature sensor's output signal; (3) analog-to-digital converter (ADC); (4) microprocessor; (5) digital-to-analog converter (DAC); (6) analog circuitry to process the output of the DAC; and (7) heating coil to control the temperature. You have been asked to develop at least two alternatives for making the controller tolerant of **any two faulty components**. The term "component" means one of the blocks of functionality listed above, **excluding the heating coil**.
    a. Show block diagrams of your two approaches and compare them qualitatively. Note that your designs should be able to handle faults of any two components, including any two same components (e.g., 2 ADCs) and any two different components (e.g., 1 ADC and 1 temperature sensor).
    b. Which approach would you recommend for implementation and why?

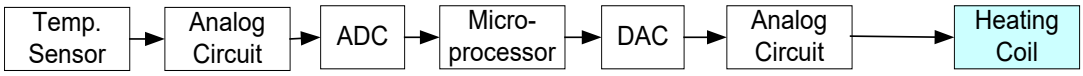

Figure 1. Block diagram of a non-redundant Controller