ECE 313
Homework 3
Due Date: March 6th

Show your work to get partial credit.

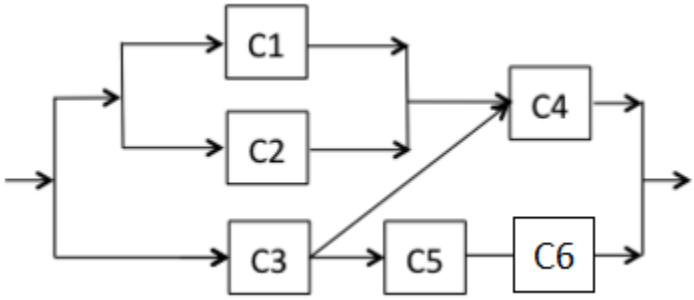
Problem 1 – Manufacturing process of a new Phone named ”16” can introduce defects in hardware (A), system-software(B) and firmware(C), with probabilities 0.04, 0.08 and 0.1 respectively. Assume that the defects are mutually independent. What is the probability that a randomly chosen Phone

a) Does not have any kind of defects?

b) (i) Is defective?
(ii) Has defects B and C only?

c) Given that the phone is defective, has all three defects?

Problem 2 – Consider the non-series-parallel system of six independent components shown in the following figure. The system is considered to be functioning properly if all components along at least one path from input to output are functioning properly.



Determine an expression for system reliability as a function of component reliabilities (R). Please denote the reliability of C1 as R1, the same applies to other components.

Problem 3 – A communication channel receives independent pulses at the rate of 12 pulses per microsecond ($12\mu s^{-1}$). The probability of a transmission error is 0.001 for each pulse. Compute the probabilities of:

a) No errors per microsecond

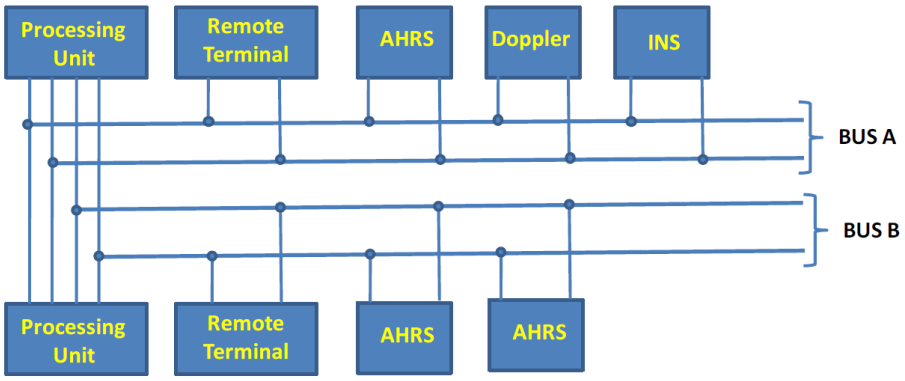
b) One error per microsecond

c) At least one error per microsecond

d) Exactly two errors per microsecond

Problem 4 - Two factories A and B manufacture clocks. Factory A produces on the average one defective item out of 50, and B produces on the average one bad clock out of 100. A retail marketing shop, which markets clocks under its brand name, regularly orders clocks without any manufacturer label from both factories A and B. One day, the retailer receives a container of clocks, but he does not know which company has sent it. So a personnel opens the box and takes out the first clock and checks, turns out that it is functioning well!
a) What is the probability that the second clock in the lot is also good?
b) Given that the second clock is good, what is the probability that the container came from factory A?

Problem 5
The system shown in the figure below is a processing system for a helicopter. The system has dual-redundant processors and dual-redundant remote terminals. Two buses are used in the system, and each bus is also dual-redundant.
The interesting part of the system is the navigation equipment. The aircraft can be completely navigated using the Inertial Navigation System (INS). If the INS fails, the aircraft can be navigated using the combination of the Doppler and the attitude heading and reference system (AHRS). The system contains three AHRS units, of which only one is needed. This is an example of functional redundancy where the data from the AHRS and the Doppler can be used to replace the INS, if the INS fails. Because of the other sensors and instrumentation, both buses are required for the system to function properly regardless of which navigation mode is being employed.



1. Identify the components that are in series and those that are in parallel.
2. Draw the reliability block diagram of the system. (hint: Refer to Lecture 6, slides 12 to see the example of reliability block diagram)
3. Calculate the reliability of the system using the information given in the table below:

Component Reliability		
Processing Unit	(R_{PU})	0.92
Remote Terminal	(R_{RT})	0.95
AHRS	(R_{AHRS})	0.88
INS	(R_{INS})	0.85
Doppler	(R_{DOP})	0.90
Bus	(R_{BUS})	0.88

4. Assume that when the Inertial Navigation System (INS) fails, switching to the AHRS/Doppler system happens with a probability of 90%. How does the reliability block diagram of the system change? Calculate the reliability of the system using this new information.