UNIVERSITY OF OSLO

Faculty of Mathematics and Natural Sciences

Exam in : FYS 3240/4240
Day of exam: : 16. June 2016
Exam hours: : 09.00 – 12.00
This examination paper consists of 2 pages.

Permitted materials: : Calculator

Make sure that your copy of this examination paper is complete before answering.

Problem 1

a) Why is Manchester encoding and 10b/8b encoding used?
b) Explain Manchester encoding.
c) How can a Manchester encoded signal be decoded to recover the original data? Explain.
d) What is a bang-bang controller? Given an example of a typical bang-bang controller.
e) Explain how a PID controller works.
f) In estimation, what is the difference between filtering and smoothing?
g) Given the digital filter below; explain how it works

$$\hat{x}_k = (1 - \alpha)\bar{x}_k + \alpha\tilde{x}_k.$$

Problem 2

a) What are the main characteristics of a real-time system?
b) Give an example of a system with only soft real-time requirements. Justify your answer.
c) What is NI-DAQmx?
d) Assume that you are making a DAQ system. When you do a test with a sinus input signal the signal you get from your DAQ-system is like shown in Figure 1. Explain what could cause such a behavior.
e) Why are USB 3.1 Gen 2 and Thunderbolt v3 interesting options for instrumentation?
f) Assume that you are designing a rocket telemetry system. You are told that each analog input channel should have a minimum passband from dc to 5 kHz, and 16 bit ADCs are to be used. The sample rate of each channel is 30 kHz. What are the minimum requirements of the anti-aliasing <u>low pass filter stop band</u> in order to satisfy Nyquist's sampling theorem and to effectively use all the bits in the ADC?
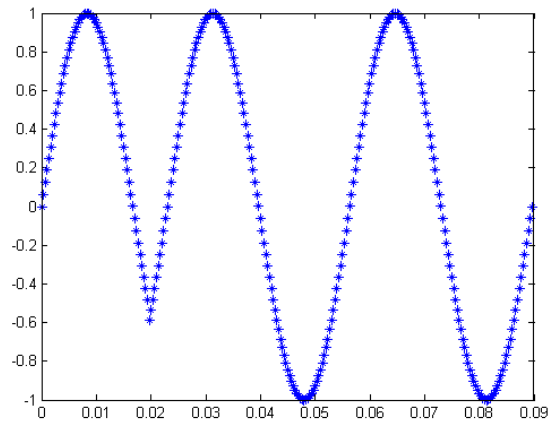g) Explain "big-endian" and "little-endian".

Figure 1

h) What is TDMS?

Problem 3

a) Explain how the clock is maintained by the operating system on a personal computer.
b) Explain two solutions used to improve the accuracy of crystal oscillators.
c) Why is the International Atomic Time (TAI) different from the Coordinated Universal Time (UTC)?

d) Explain hardware timing and software timing in a DAQ-system