

UNIVERSITY OF OSLO

Faculty of Mathematics and Natural Sciences

Exam in : FYS 3240/4240
Day of exam: : 14. juni 2011
Exam hours: : 09.00 – 12.00
This examination paper consists of 2 pages.

Permitted materials: : None

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

Problem 1

- a) Explain how data is transferred from a data acquisition card to the hard disk on a PC by using DMA.
- b) Explain why hard drive-based RAID systems are used, and explain what RAID configuration you would have chosen in order to write measurement data to disk as fast as possible.
- c) Given that you have to build a PC-based data acquisition system to record video data from a color camera with a resolution of 640 x 480 pixels and a frame rate of 200 frames / second. This generates a data rate of about 246 MB/s to be saved to disk with 4 bytes for each pixel.. Answer the following questions:
 - i. Explain and justify the type of software structure you will use in your program to collect data (read data from the camera) and write them to a file.
 - ii. Will the choice of file format have a major impact on how quickly you can write data to disk? Justify your answer.
- d) Given that you have to make a PC-based data acquisition system to measure analog signals (voltages) from a sensor with 4 analog outputs, each within 0 V to 0.5 V. The signals from the sensor are transmitted over a long cable that is exposed to external noise sources. Answer the following questions and justify your answers:
 - i. What is meant by, respectively, differential and single-ended connection/transmission, and what kind of connection/transmission would you choose?
 - ii. Do you need any external signal conditioning before the data acquisition card?

Problem 2

- a) List some characteristics and differences for the PCI and the PCI Express bus.
- b) Given that you have to build a distributed PC-based data acquisition system where multiple computers are connected together to exchange collected data and make

distributed processing. The distance between the PCs is up to 25 meters, and data to be transferred between the PCs have a data rate of up to 10 MB/s. Synchronization of all computer clocks also has to be implemented. Answer the following questions:

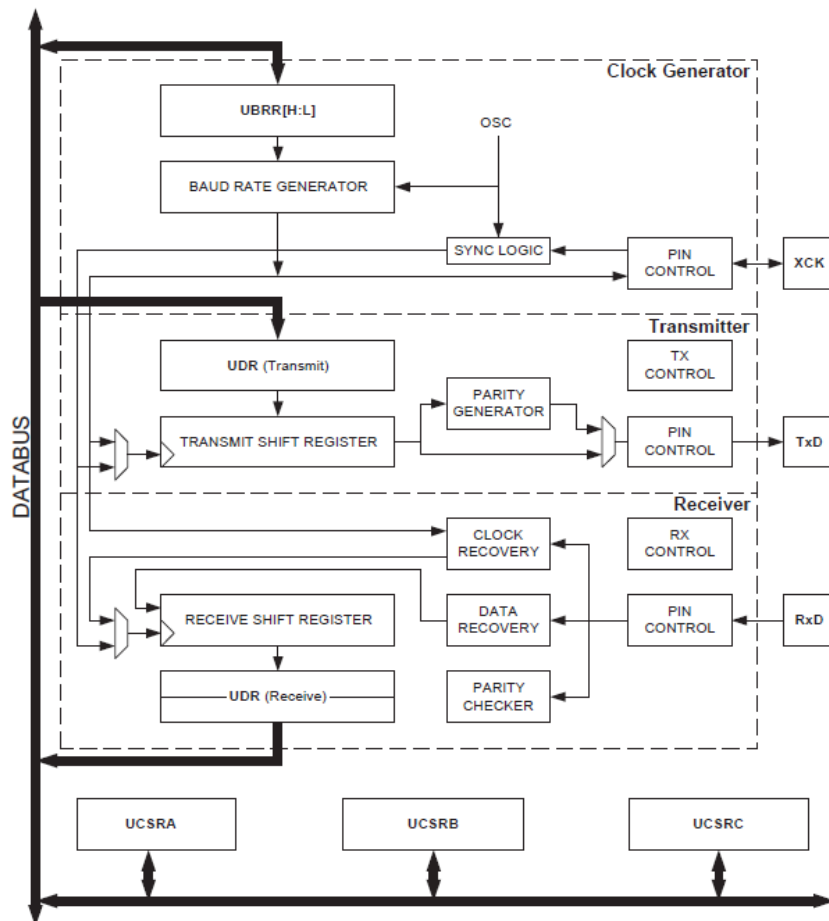
- i. What kind of data bus would you choose to connect the PCs? Justify your answer.
- ii. Sketch a solution to synchronize clocks on the different PCs with an accuracy within milliseconds range or better.

Problem 3

- a) List some differences (minimum 3) between a microcontroller and a microprocessor that is used in a typical PC.
- b) Write a complete program in C for the microcontroller ATmega16 that does the following:

Read an 8 bit data word on PORTA when an interrupt is generated on the IRQ line **SIG_INTERRUPT0**. The data read from PORTA is to be written to the UART in order to be transmitted to a PC by an RS-232 connection.

Hint: if you do not remember all the syntax in C or the name of registers you can use pseudo code and/or explain what features you need.



Figur 1: USART blokkdiagram