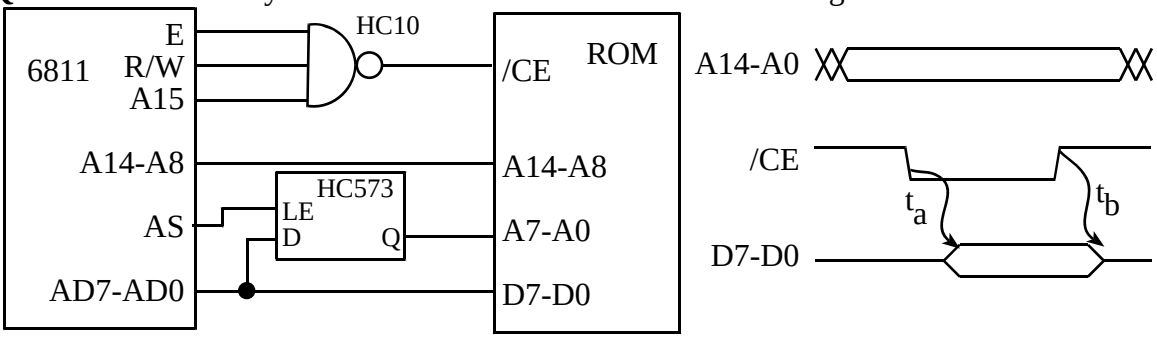
Jonathan W. Valvano First:_____ Last:_____

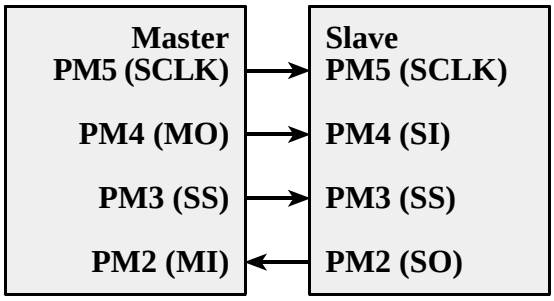
April 13, 2007, 1:00pm-1:50pm. This is an open book test. You have 50 minutes, so please allocate your time accordingly. ***Please read the entire quiz before starting***.

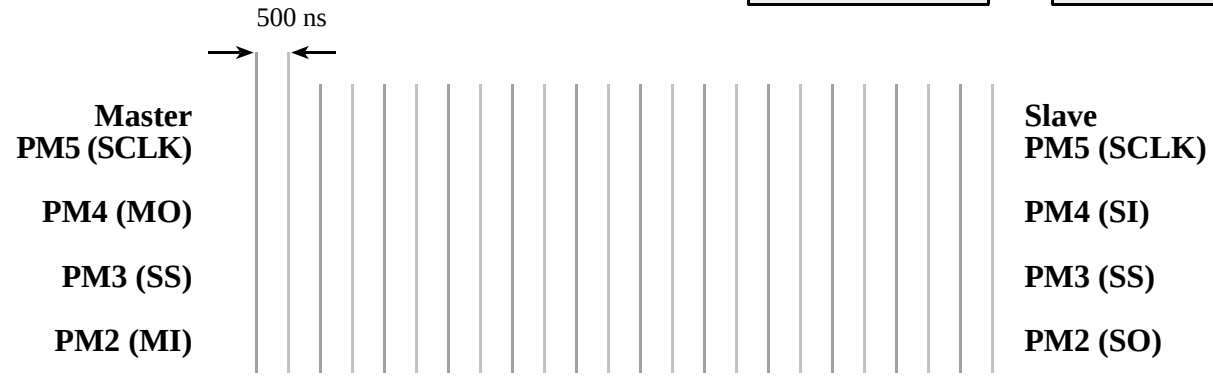
(15) Question 1. A 32k by 8 bit PROM is interfaced to a 6811 running at 2 MHz as shown below



Assume t_a = [100ns, 150ns], and t_b = [15ns, 20ns]. Assume the gate delays through the 74LS10 and 74HC573 are [10ns, 15ns]. Determine Read Data Available (RDA) and Read Data Required (RDR). Give your answer in numerical form, defining 0ns at the start of the cycle.

(15) Question 2. Two 6812's are to be interfaced together using their SPI ports. Both the master 6812 and the slave use CPOL=1, CPHA=0 mode, and the SCLK frequency is 1 MHz. The control bits MODFEN and SSOE are both 1. Sketch the waveforms for one frame occurring if the master transmits \$0F and the slave transmits \$F0. Show what you would see on an oscilloscope (actual data output, not required input data.)





(15) Question 3. Design a minimal-cost positive-logic address decoder for *YourDevice* in the following system. The inputs are A15, A14, …A0 and the output is **Select**. Positive logic means **Select**=1 when *YourDevice* should be activated, and **Select**=0 when *YourDevice* is deactivated.

RAM	$4000-$47FF	Show 1) design steps,
YourDevice	$5000-$57FF	2) logic equation,
ROM	$6000-$7FFF	3) digital logic circuit.
ROM	$C000-$FFFF	

Give chip numbers, but not pin numbers (design just the decoder for *YourDevice*, not all of them)

(55) Question 4. You will design a data acquisition system to measure distance. The range of displacement is 0 to 10 m. The linear transducer has a sensitivity of 0.02 V/m. The distance signal exists in the 0 to 499 Hz frequency band. You will measure the ADC at a fixed rate, convert each sample to fixed-point, and send each fixed-point measurement to the PC using the SCI. The ADC sampling must occur in real-time using an output compare periodic interrupt **channel 0**. The SCI transmissions must occur in the main program (foreground thread.)
Part a) Choose the sampling rate. Explain why you chose that value.

Part b) The transducer output (V_{out}) is a differential voltage, with a range of 0 to 0.2V. The individual transducer output voltages are about 2.5V. A good CMRR is required. Design the analog circuit mapping the transducer output into the ADC input channel 5. (You do not have to add an antialiasing analog low pass filter.) Show chip numbers, resistor values, but not pin numbers.

Part c) Assuming the only error occurs in the 10-bit ADC, what is the expected distance measurement resolution in meters?

Part d) Given your answer to part c) choose a fixed-point format that matches this resolution. Write a C function that converts the 10-bit ADC sample (0 to 1023) into distance as a fixed-point number.

Part e) Write the entire program that implements this real time data acquisition system. You are allowed to call the following functions (without showing the implementations of these functions).

```
PLL_Init();            // initializes the PLL, changing the E clock to 24 MHz
ADC_Init();            // initializes the ADC
data=ADC_In(0x85);     // returns 10-bit sample from channel 5, 0 to 1023
SCI_Init(115200);      // initializes the SCI at 115200 bits/sec
SCI_OutChar(13);       // sends a CR to the PC
SCI_OutFix(distance);  // sends a fixed-point data to the PC, your resolution
Fifo_Init();           // initializes a first in first out queue
Fifo_Put(data);        // saves a 16-bit data into the fifo, returns -1 if full
Fifo_Get(&data);       // removes a 16-bit data from the fifo, returns -1 if empty
```

If you need other functions, you will have to show their implementations.