

CMPE 127 Midterm Exam  
(Fall 2011)

First Name: [redacted]

Last Name: [redacted]

14.75

75

This test has total 20 points. Please be sure to provide a step-by-step result for the questions that involve calculation.

1. (5 points) Answer the following questions:

1.1 (1 point) What is general purpose register? How many GPRs are there for 8086 and name each of them and their size.

A general purpose register is for performing meaning full operations.  
There are 4 GPRs: Ax 16 bits, Bx 16 bits, Cx 16 bits, Dx 16 bits. Algorithmic/Logic operations.

1.2 (1 point)

1.2.1 Explain what is Von Neumann Architecture?

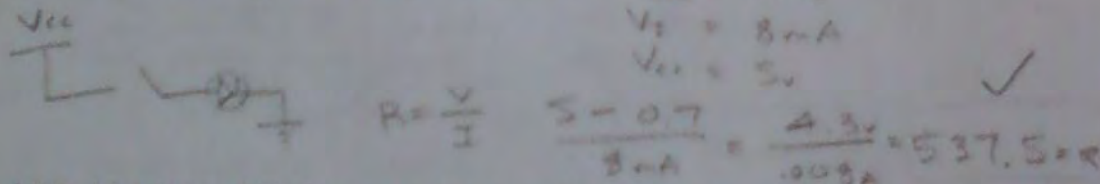
1.2.2 Does ARM7TDMI belong to this class and why?

1) Von Neuman Architecture:  
- has uni-processor  
- tightly integrated memory  
- data/instructions are shared bus.  
2) ARM7TDMI belongs to this class because it has these features.

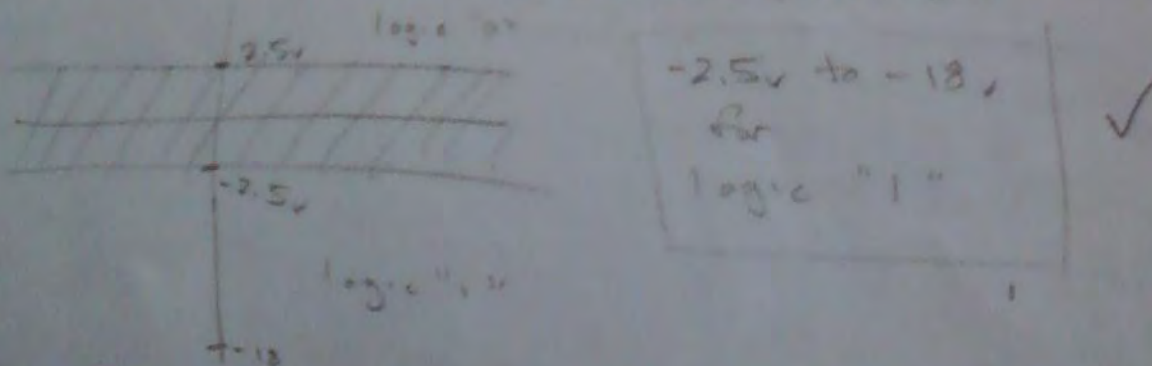
1.3 (1 point) What does RISC stand for? Is the current CPU RISC processor? Is 8086 RISC processor?

RISC = Reduced Instruction Set Computing.  
ARM7 is RISC but the 8086 is not.  
8086 is CISC.

1.4 (1 point) In your prototyping board power unit design, LED is needed when the power connection is on, draw a simple circuit to realize this function and calculate the resistor value if needed (Suppose  $I = 8mA$ )? Assume:  $V_{LED} = 0.7V$



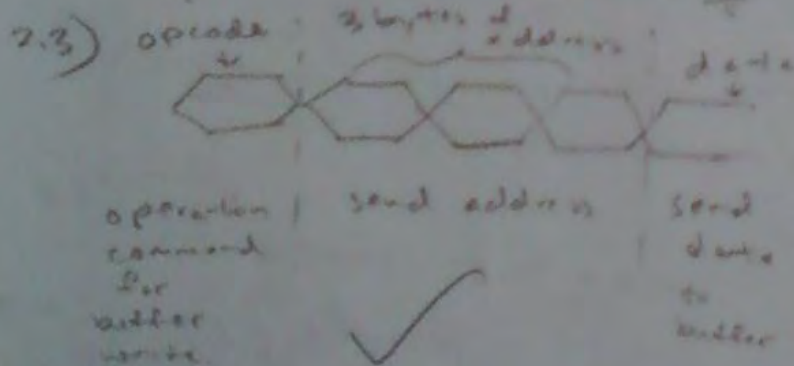
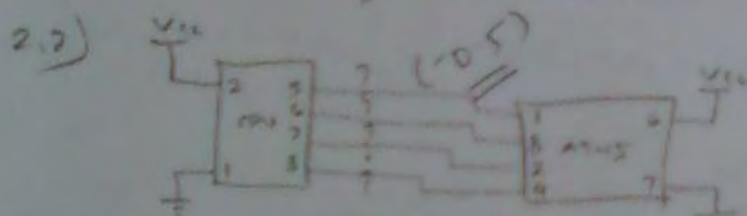
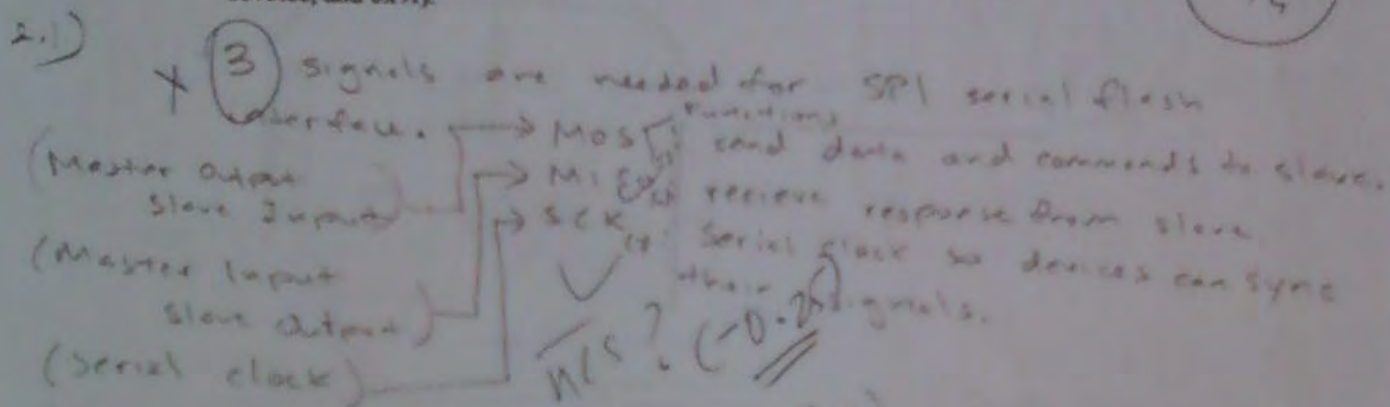
1.5 (1 point) In lab 1 design, RS232 communication is established for debugging purpose, at the output of MAX232 to the connector, what is the voltage level for logic 1?



2. (5 points), Complete CPU to SPI serial flash interface design by answering the following questions:

- 2.1 (1 point) How many signals are needed for SPI serial flash interface design? Name each of them and their function?
- 2.2 (1 point) Complete your design for CPU to SPI serial flash interface by schematics?
- 2.3 (1 point) Draw a timing diagram for SPI buffer write operation, use dashed line to divide them to 3 functional segments according to the SPI interface protocol function, and explain the function for each segment?
- 2.4 (2 pts) Write short C program using mbed APIs, to define SPI interface supposed CPU pins 5,6,7 are used, then write C program to read device ID (Suppose AT45 device, and 0x9f).

2.1  
4  
2.5  
1.5



2.4)

```

#include "mbed.h"
Serial pc (p9, p10);
DigitalOut wcs (p8);
SPI spi (p5, p6, p7);

int main () {
    wcs = 1;
    spi.format (3, 0);
    spi.frequency (1000000);
    wcs = 0;
    spi.write (0x9f);
    int ID = spi.write (0x00) << 8;
    ID |= spi.write (0x00);
    wcs = 1;
    pc.printf ("ID is 0x%.X\n", ID);
}
    
```



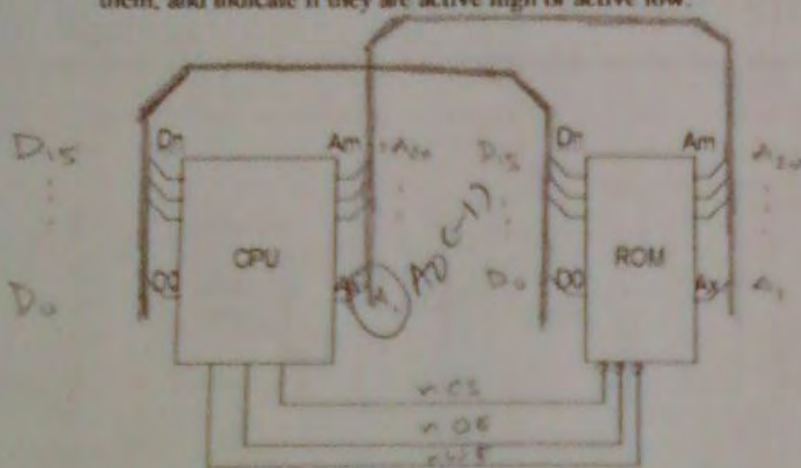
3. (5 points) Given below is a unfinished ROM memory interface design, suppose CPU is on the left and ROM is on the right, answer the following questions,

3.1 (1 point) Suppose the ROM is 16 Mbit x 16, what is the data bus width?  $D_n$ ? How many bits of address bus are needed? *Data bus width is 16.*

3.2 (1 point) In the case of this design, what is  $A_x$  (on the CPU side)? And why?

3.3 (2 points) Finish the connection of data bus and address by drawing data and address buses below, be sure to indicate the right starting and ending bits of data bus and address bus.

3.4 (1 point) Three control signals are needed in this design, give the name of each of them, and indicate if they are active high or active low.



3.1)  $\frac{16 \text{ Mbits}}{8} = 2 \text{ MBytes} = 2 \cdot 2^{20} = 2^{21}$   $D_n = D_{15}$  ✓  
 $\frac{2 \cdot 2^{21}}{16 \text{ bits} = 2 \text{ bytes}} = 2^{20}$  20 bits of Address bus

3.2)  $A_x = A_1$  because the data bus is 16 bits which is 2 bytes so we drop  $A_0$ .

3.3) As shown in figure.

3.4) ? (-1)



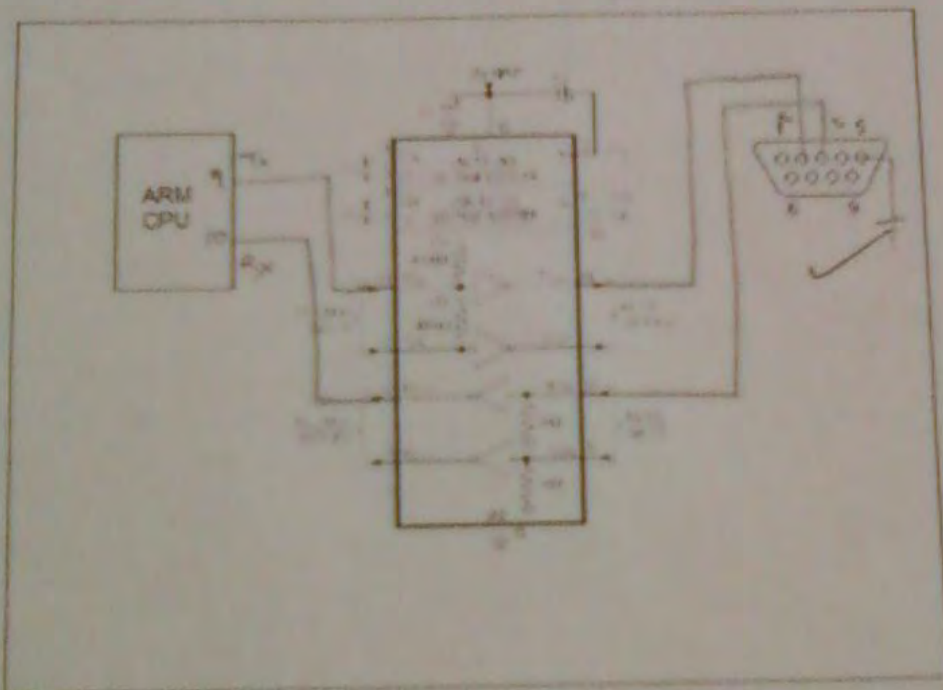
4. (5 points) RS232 serial interface is one of the key interfaces for debugging the microprocessor system, based on the system block diagram below, answer the following questions:

4.1 (1 pt) How many UART ports for the ARM CPU? And what is the voltage value for UART's local high? And what is the voltage value for RS232's logical high?

4.2 (1 pt) complete the un-finished design below (a) draw the pins with pin number for Tx and Rx of the CPU; (b) form a serial data bus by connecting these pins to MAX232; (c) then connect the MAX232 output to DB9 connector.

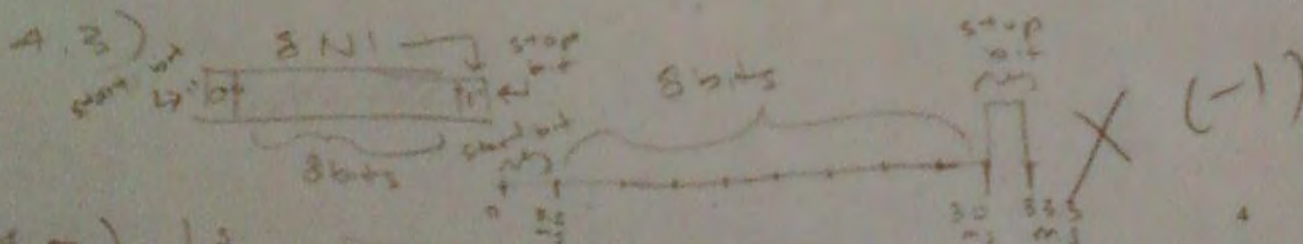
4.3 (1 pt) Draw a timing diagram of the RS232 data frame for 300 bps 8N1 communication, suppose the data payload is logical 0. Be sure to indicate the starting and ending frame.

4.5 (2 pts) Calculate the timing, e.g., find the time interval for a single bit?



4.1) There are 3 UART Ports for ARM CPU.  
UART's local high is 3.3v. ✓  
RS232's local high is -2.5 to -15v. ✓

4.2) As shown in figure



4.5)  $\frac{1}{3000} = 3.33 \text{ ms per bit}$   
time total takes 33.3 ms ✓