Embedded Systems (0907333)
Homework 1
Submit Handwritten Solutions

Problem 1: State seven features of the PIC microcontrollers.

Problem 2: What is the main difference between PIC 16C84 and PIC 16F84?

Problem 3: Describe how EPROMs are programmed and erased.

Problem 4: What is the main difference between EEPROM and Flash memories?

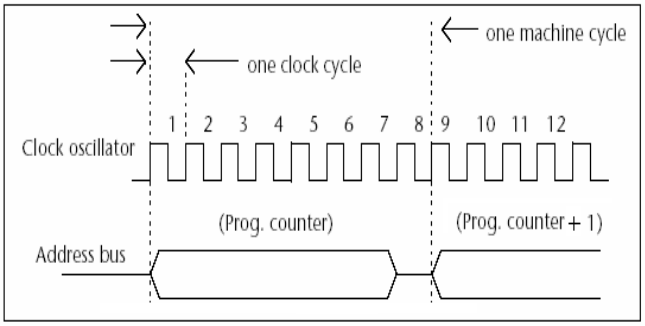
Problem 5: Draw the PIC 16F84A architecture.

Problem 6: Draw the PIC 16F84A status register.

Problem 7: Summarize the steps to write one byte in PIC 16F84A's EEPROM.

Problem 8: A microcontroller has the following features:

(a) 8 bit microcontroller
(b) 10-entry stack
(c) 200-ns minimum instruction execution cycle
(d) 30 instructions
(e) 15-bit wide instruction words
(f) 10-bit data memory address bus
(g) 10-bit program memory address bus
(h) All instructions execute in one cycle



According to the above specifications, answer the following questions:

1. Describe in one line *only* what we mean by the first two features.
2. Find the maximum operating frequency for the above microcontroller.
3. The size of the data bus is ___ bits.
4. The maximum program memory size is _____.
5. Is this microcontroller's core architecture is Von Neumann or Harvard? _____.
6. Is its instruction set is RISC or CISC? _____.
7. The width of the Program Counter (PC) register is _____ bits.

Problem 9: Read the following code carefully, and then answer the following questions:

```
#include "p16F84.inc"   ; Assume external clock Frequency is 8 MHz
      cblock 0x22
             Count
      endc

      org 0x05
yy
      movlw   D'34'
      movwf FSR
      movlw 33
      clrf  Count
      subwf Count,W
      movlw 2
      addwf PCL,W
      goto  xx
      goto  yy
      goto  zz
xx
      btfsc Count,4
      goto  zz
      nop
      incf  Count,F
      goto  xx
zz
      movf  INDF,W
      nop
      end
```

a) The program flow between the two arrows is called _____
b) The delay between the two arrows equal to _____ µs
c) The basic element of assembly language `yy` is called _____
d) The instruction that is executed after `addwf PCL,W` is _____
e) The machine code of instruction `clrf  Count` is _____
f) The value of W and the three status flags after execute `subwf Count,W` is _____
g) The value of W after executing the entire code above is _____
h) The address of instruction `goto yy` in the program memory is _____

Problem 10: The Harvard memory structure gives some clear advantages over the von Neumann. Can you think of any disadvantages? (Consider and expand on: system complexity, flexibility of memory utilization, ease of accessing data tables in program memory, access to Stack).

Problem 11: A microcontroller system is to generate a sine wave, taking values from a look-up table, and transferring them to a digital to analog converter (DAC). Negative values must be converted to two's complement. The table contains values from 0^o to 90^o, in increments of $2^{o.}$. Draw a flow diagram showing how the values from the table should be accessed and manipulated, in order to produce the required output.