EE2016 Microprocessors Theory and Lab

Tutorial 4 (1st 3 weeks of Aug. 2019)

(You may refer AVR manuals)

1 Fill in the blanks

1. The number of machine cycles for the instructions IN and LDS is ..... and ..... respectively.
2. The instruction length for IN and LDS is ..... and ..... respectively.
3. GPRs are ..... (internal/ external) to the CPU/ microcontroller.
4. The instruction "ADD R13, R6" puts the result in .....
5. Mention the technology used to realize each of the following in a microprocessor / microcontroller: (a) GPR (b) I/O registers (c) code / program memory (d) data memory - temporary (e) data memory - nearly permanent

2 Solve all the problems

1. Find the C, Z and H flag bits for the following code:

   LDI R20, 0x67

   LDI R21, 0x99

   ADD R20, R21

2. Fibonacci Series is a series in which the next number is found by adding up the two numbers before it. It starts with 0 and 1 as the first 2 numbers. Write an AVR assembly language program to generate the first 10 numbers in Fibonacci series and save them in registers R11, R12, R13... R20.
3. Registers R11-R15 are loaded with some numbers. Write a program in AVR processor to find out how many unique/distinct values are present in those. For eg. if the numbers loaded are 1,3,4,4,1 then the answer is 3 whereas if the numbers are 1,2,4,5,6 the answer is 5

4. For every instruction, in each clock cycle, the data bus, address bus, control signals of an execution unit, ALU function lines and flag lines take a specific value. We could think of a binary word with fields as above in that order. See the fig below.

Data bus	A4	A3	A2	A1	A0	RD	WR	LD	IA	C1	C0	Flag Register

For each of the instructions given below, evaluate the value for this (binary) word for each clock cycle. [Note: this binary word is what is mentioned as 'Piono' control keys]

(a) INC R5

(b) ADD R21, R22, R23

(c) MVI R(R5), R23

(d) SUB R21, R22,

Information: For function lines refer below:

Function Select lines	Function
00	ADD
01	COMPARE
10	SUBTRACT
11	INC