

EE2016 Microprocessors Theory and Lab

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Tutorial 3 Solutions (Classes on 12 & 13 of Aug. 2019)

Dr. R Manivasakan

1 Fill in the blanks

1. Different addressing schemes in microprocessors/ microcontrollers
 - (a) Immediate addressing
 - (b) Register addressing
 - (c) Register indirect addressing
 - (d) Direct addressing
 - (e) Indexed addressing
 - (f) Flash direct addressing
 - (g) Flash indirect addressing
2. Advantages and disadvantages of indirect addressing scheme
 - (a) Advantages: By using indirect addressing scheme, the accessing of data is dynamic rather than static. For example, since using indirect addressing mode accesses the memory, the data can be easily changed according to the requirements of the user. Also, for requirements like accessing the data from arrays, lookup tables etc, indirect addressing is the most suitable method since the data can be saved in a set of memory locations and program can access the data using a loop rather than increasing the number of instructions in the main program.
 - (b) Disadvantages: The main disadvantage is the increase in the number of clock cycles for accessing the memory location in indirect addressing mode.

3. The SRAM memory is accessed using indirect addressing mode by using the 16 bit registers X, Y and Z, with the instructions LD or LDD and ST or STD. The flash/ eeprom memory accessing is also indirect addressing by using the register Z and by using the instructions LPM or SPM.
4. CMP means compare, which is used to compare the contents of accumulator/ register with another register or with the contents in a memory location. CP Rd, Rs doesn't change the contents of Rd and Rs. Instead, it affects the flags H, S, V, N, Z, C. 1 cycle it takes to execute.
5. Immediate addressing

2 Problems

1. Assembly program
 - (a) If line (f) is not there, always R5 will be loaded with the value 1 irrespective of whether carry flag was set or not after the addition instruction.
 - (b) $Z = 0$, $C = 0$, $N = 1$, $H = 0$, $V = 1$, $S = 0$
 - (c) 90
2. Indirect addressing scheme
 - (a) R4, yes it's a pointer register.
 - (b) X register is the analogous one (16 bits) with XL holding the lower 8 bits analogous to R4 in QEEE.
 - (c) $XL = 20$.
 - (d) The program adds a set of numbers stored in SRAM locations from 0011 to 0020 and stores the result in R18.