Chapter 3: 3, 6, 12, 14, 32, 35 (see below for textbook problems)

Additional problems:

1. For the program below, answer the following questions. a) Determine the time delay in ms in the DELAY subroutine. b) What action/operation is performed in the loop AGAIN? Assume that the crystal frequency is 8 MHz and the system is using an ATmega32.

.ORG 0

LDI R16,HIGH(RAMEND)

OUT SPH,R16

LDI R16, LOW(RAMEND)

OUT SPL,R16

LDI R16,0x40

AGAIN: COM R16

OUT PORTD,R16

CALL DELAY

RJMP AGAIN

DELAY: LDI R19,50

LOOP1: LDI R20,100

LOOP2: LDI R21,200

LOOP3: NOP

DEC R21

BRNE LOOP3

DEC R20

BRNE LOOP2

DEC R19

BRNE LOOP1

RET

1. Find the time delay of the following program assuming an oscillator frequency of 4 MHz. Modify the program to achieve the same delay using a nested loop.

DELAY: LDI R17, 100

LOOP1: NOP

NOP

NOP

NOP

NOP

NOP

NOP

NOP

NOP

NOP

DEC R17

BRNE LOOP1

RET

1. Given the following sequence of code. Determine the values of the SP and registers specified after each instruction is executed.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | SP | R16 | R24 | R25 | R26 | R27 |
| .ORG 0 |  |  |  |  |  |  |
| LDI R16, HIGH(RAMEND) |  |  |  |  |  |  |
| OUT SPH, R16 |  |  |  |  |  |  |
| LDI R16, LOW(RAMEND) |  |  |  |  |  |  |
| OUT SPL, R16 |  |  |  |  |  |  |
| LDI R24, 0x10 |  |  |  |  |  |  |
| LDI R25, 0x48 |  |  |  |  |  |  |
| LDI R26, 0x30 |  |  |  |  |  |  |
| LDI R27, 0x09 |  |  |  |  |  |  |
| PUSH R26 |  |  |  |  |  |  |
| PUSH R24 |  |  |  |  |  |  |
| PUSH R27 |  |  |  |  |  |  |
| POP R24 |  |  |  |  |  |  |
| POP R26 |  |  |  |  |  |  |
| POP R25 |  |  |  |  |  |  |

1. Given the following assembly language instruction sequence and machine codes for the instructions. In the table below, fill in the starting memory location and machine code for each instruction. Show the calculations for the jump instruction to determine the branch addresses as given by the determined machine code values. See Example 3-7.

|  |  |  |
| --- | --- | --- |
| Starting Code Memory Location for Instruction | Machine Code (see below for different instructions) | Assembly Language Program Instruction |
| $00000 |  | LDI R21, 0x40 |
|  |  | LDI R30, 2 |
|  |  | AGAIN: ADD R21,R30 |
|  |  | BRNE AGAIN |



BRNE BranchPlace; conditional branch -> branch if C = 0

|  |  |  |  |
| --- | --- | --- | --- |
| 1 1 1 1 | 0 1 K6 K5 | K4 K3 K2 K1 | K0 0 0 1 |

K6 K5 K4 K3 K2 K1 K0 = > -64 to +63 (2s complement range) offset with respect to the current PC

1. Write an assembly language program for the ATmega32 to compute the sum of 0x3C, 0x57, 0xA6. Store the result in registers R30 (low byte) and R31 (high byte). See example 3-5
2. Show the status of the C, H, V, S, and Z flags from SREG for the following program segment.

LDI R16, 0x87

LDI R20, 0x9D

SUB R16, R20

Chapter 3 Problems





