# LAB 4-C

# 7-SEGMENT

## OBJECTIVES:

☐ To interface seven-segment to the AVR simulator.

## MATERIAL:
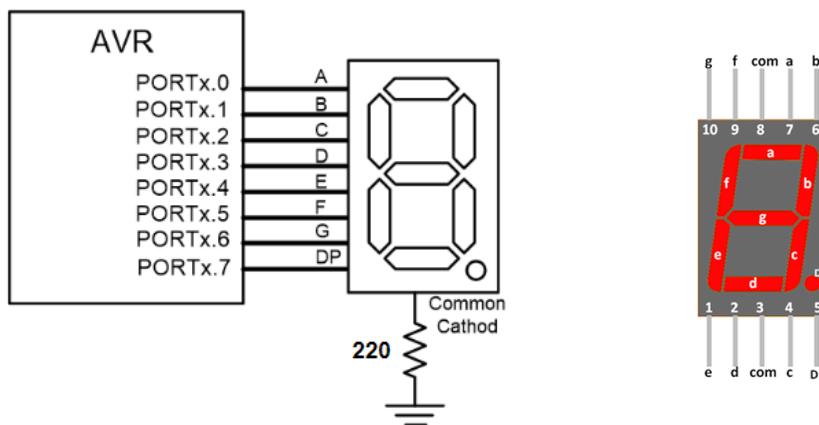
☐ Atmel Studio or the assembler of your choice.

☐ https://lcgamboa.github.io/js/picsimlab.html?../picsimlab_examples/ (Simulator)

## WEB SITES:

☐ www.microchip.com       for Atmel Studio Software

## ACTIVITY 1

a) Connect a common cathode 7-segment directly to PORTD.



b) Write the following program in the AVR Studio, build and download to the picsimlab.

```
        LDI     R20, 0xFF
        OUT     DDRD, R20
        LDI     R20, 0b00000111
        OUT     PORTD, R20
HERE: RJMP     HERE
```

## ACTIVITY 2

Modify the previous program to display 9 on the 7-segment.

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```
.INCLUDE "m328pdef.inc"

.ORG 0x0000

LDI R20, 0xFF

OUT DDRD, R20 ; Set PORTD as Output


LDI R20, 0x6F ; Load hex code for '9' (Binary 01101111)

OUT PORTD, R20 ; Output to 7-segment


HERE: RJMP HERE
```

## ACTIVITY 3

Use a **look-up table** to write a subroutine that displays the value stored in R21 on the 7-segment.

```
 .INCLUDE "m328pdef.inc"

.CSEG

.ORG 0x0000


LDI R16, LOW(RAMEND)

OUT SPL, R16

LDI R16, HIGH(RAMEND)

OUT SPH, R16


LDI R16, 0xFF

OUT DDRD, R16

; Example: Display '5'

LDI R21, 5

RCALL DISPLAY_DIGIT
```

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HERE: RJMP HERE

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DISPLAY_DIGIT:

```
LDI ZL, LOW(2*SEG_TABLE) ; Load Z pointer with table address

LDI ZH, HIGH(2*SEG_TABLE)


ADD ZL, R21 ; Add offset (the number to display)

LDI R16, 0

ADC ZH, R16 ; Handle carry for high byte


LPM R16, Z ; Load bit pattern from Flash

OUT PORTD, R16 ; Send to 7-segment

RET

; ------------------------------------------

; Look-up Table (0-9 Common Cathode Codes)

; ------------------------------------------

SEG_TABLE:

.DB 0x3F, 0x06, 0x5B, 0x4F, 0x66 ; 0, 1, 2, 3, 4

.DB 0x6D, 0x7D, 0x07, 0x7F, 0x6F ; 5, 6, 7, 8, 9
```
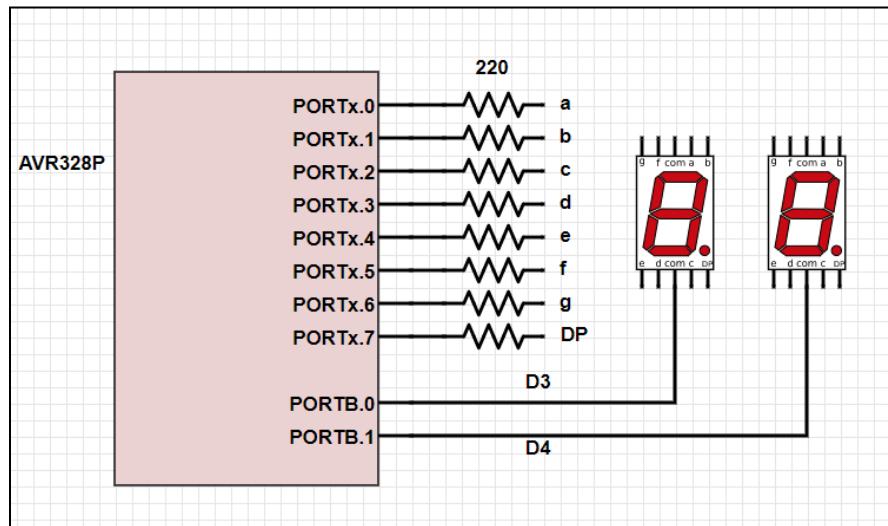
## ACTIVITY 4
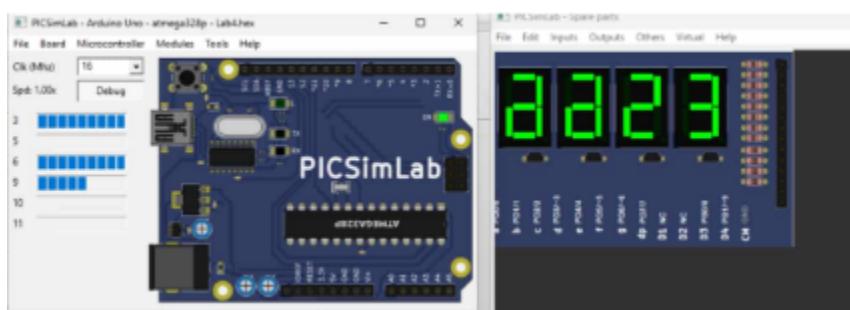
    a)   Connect two 7-segments to the same port of AVR, as shown below.

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b) Display 23 by scanning on those two 7-segments.



.INCLUDE "m328pdef.inc"

.EQU DIGIT_1_PIN = 0 ; PORTB.0 for Left Digit

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.EQU DIGIT_2_PIN = 1 ; PORTB.1 for Right Digit

.ORG 0x0000

; 1. Configure Ports

LDI R16, 0xFF

OUT DDRD, R16 ; PORTD as Output (Segments)

OUT DDRB, R16 ; PORTB as Output (Control)

LOOP_SCAN:

; --------------------------

; Display '2' on Left Digit (Digit 1)

; --------------------------

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LDI R16, 0x5B ; Segment code for '2'

OUT PORTD, R16


CBI PORTB, DIGIT_1_PIN ; Enable Digit 1 (Low)

SBI PORTB, DIGIT_2_PIN ; Disable Digit 2 (High)


RCALL DELAY_SHORT ; Small delay for visibility

; --------------------------

; Display '3' on Right Digit (Digit 2)

; --------------------------

LDI R16, 0x4F ; Segment code for '3'

OUT PORTD, R16


SBI PORTB, DIGIT_1_PIN ; Disable Digit 1 (High)

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```
CBI PORTB, DIGIT_2_PIN ; Enable Digit 2 (Low)


RCALL DELAY_SHORT ; Small delay


RJMP LOOP_SCAN ; Repeat
; ---------------------------
; Short Delay Subroutine
; ---------------------------
DELAY_SHORT:
 LDI R17, 20 ; Adjust this value for scan speed
D1: LDI R18, 255
D2: DEC R18
 BRNE D2
 DEC R17
 BRNE D1
 RET
```