

NAME: _____

**FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MALAYSIA**

TEST 2 (20%) SEMESTER 2 SESSION 2010/2011

SUBJECT: MICROCONTROLLER (SEL4533)
DURATION: 1 HOUR

One simple system using microcontroller M68HC11 based on boot strap mode is created to perform two tasks as shown in Figure 1. PORTB of the microcontroller is connected to seven-segment display and two push-on switches are connected to PORTC bit 0 and 1 (PC0, PC1). The two switches are used to choose two different functions. The first switch at PC0 is to display an animated sequence of '0', '1', '2' and '3' on the seven-segment display. The second switch at PC1 is to test an 8 bit number at address \$0050 if the number is a positive number. If the number is positive, '0' will be displayed on the seven-segment display and if the number is negative, '1' will be displayed on the seven-segment display. Answer all the questions below.

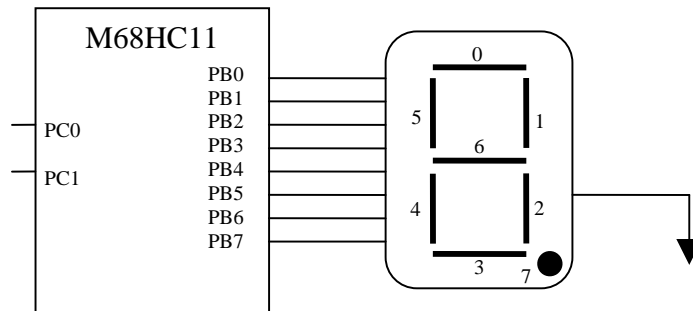


Figure 1: A simple system using microcontroller M68HC11 connected to a seven-segment display

1. Draw and complete the missing part (circuit) of the two switches connected to PC0 and PC1. Both switches *are active low*. [4 marks]

2. State the values (in Hexadecimal format) that have to send to PORTB to display '0', '1', '2' and '3' at the seven-segment display. PB0 is connected to pin 0 of the seven-segment display, PB1 is connected to pin 1, and so on and forth until pin 7. [4 marks]

	7	6	5	4	3	2	1	0	Hex
0	0	0	1	1	1	1	1	1	3F / BF
1	0	0	0	0	0	1	1	0	06 / 86
2	0	1	0	1	1	1	1	1	5B / DF
3	0	1	0	0	1	1	1	1	4F / CF

3. Create a subroutine DISPLAY_UP to display sequence of '0', '1', '2' and '3' at the seven segment with a delay of 1 *second* in between each display. Assume subroutine DELAY is already created to delay 1 *second*.

[4 marks]

```

DISPLAY  LDAA  #$3F
           STAA  PORTB,X
           JSR   DELAY
           LDAA  #$06
           STAA  PORTB,X
           JSR   DELAY
           LDAA  #$5B
           STAA  PORTB,X
           JSR   DELAY
           LDAA  #$4F
           STAA  PORTB,X
           JSR   DELAY
           RTS

```

4. Create a subroutine TEST_NUMBER to test a number at address \$0050. Display '0' at the seven-segment display if the number is positive and display '1' if the number is negative.

[4 marks]

```

TEST  LDAA  $50
           BPL   POS
           LDAA  #$06   ;NEGATIVE SO SHOWS '1'
           STAA  PORTB,X
           BRA   EXIT
POS   LDAA  #$3F   ;POSITIVE SO SHOWS '0'
           STAA  PORTB,X
EXIT  RTS

```

5. Write a full program to perform the task as mentioned above. You can use the subroutine DISPLAY_UP and TEST_NUMBER and you do not have to rewrite these subroutines.

[4 marks]

```

PORTBEQU  $04
PORTCEQU  $03
DDRC EQU   $07

           ORG  $B600 ;START OF INTERNAL EEPROM
START  LDX   #$1000
           LDAA  #%11111100 ;RC0 AND RC1 AS INPUT
           STAA  DDRC,X

           LDAA  #$F5
           STAA  $50

AGAIN  BRSET PORTC,X    %00000001    NEXT
           JSR   DISPLAY
NEXT  BRSET PORTC,X    %00000010    AGAIN
           JSR   TEST
           BRA   AGAIN

```