Homework #7

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Problem #1

$$(65536 - x) \times 1.085\,\mu s = 5\,ms = 5000\,\mu s \tag{1}$$
$$= 60928_{10} \tag{2}$$
$$= EE00_{16} \tag{3}$$

Therefore, `TH1` $= EE_{16}$ and `TL1` $= 00_{16}$

Problem #2

Assuming Problem #1 is correct,

```
        ORG 0H

        MOV R0, #100D
LOOP:   MOV TMOD, #01D
        MOV TH0, #EEH
        MOV TL0, #00H   ; (FFFF - EE00 + 1)*1.085 = 5ms
        ACALL DELAY
        DJNZ R0, LOOP   ; 100*5ms = 500 ms

        AJMP DONE

DELAY:  SETB TR0
LOOP2:  JNB TF0, LOOP2
        CLR TR0
        CLR TF0
        RET

DONE:   NOP
        END
```

Problem #3

$5\,\text{kHz} = 500\,\mu\text{s}$. So,

$$\texttt{TH1} = EE_{16} \quad \text{and} \quad \texttt{TL1} = 00_{16} \tag{4}$$

The code is as follows,

```
        ORG 0H

        MOV R0, #100D
        CLR P0.0

LOOP:   MOV TMOD, #01D
        MOV TH0, #EEH
        MOV TL0, #00H   ; (FFFF - EE00 + 1)*1.085 = 5ms
        ACALL DELAY

        CJNE R0, #75D, SKIP
        SETB P0.0

SKIP:   DJNZ R0, LOOP   ; 100*5ms = 500 ms

        AJMP DONE

DELAY:  SETB TR0
LOOP2:  JNB TF0, LOOP2
        CLR TR0
        CLR TF0
        RET

DONE:   NOP
        END
```

Problem #4

Because we know frequency $(f) = \frac{1}{\text{period }(T)}, \lfloor f \rfloor \implies \lceil T \rceil, \{\forall f, T \in \mathbb{R}^+ \mid f \neq 0, T \neq 0\}$.
Using this, we find the smallest period to be,

$$(FFFF_{16} - FFFF_{16} + 1) \cdot 1.085\,\mu\text{s} = 1.085\,\mu\text{s} \tag{5}$$

From this, we use $f = \frac{1}{T} = \frac{1}{1.085} = 0.92\,\mu\text{Hz}$. We do a similar process for lowest frequency.

```
        ORG OH
        CLR P1.3

LOOP:   MOV TMOD, #01D
        MOV THO, #0D    ; lowest frequency => highest period
        MOV TLO, #0D    ; highest period => Smallest TH, TL
        SETB P1.3
        ACALL DELAY

        CLR P1.3
        AJMP DONE

DELAY:  SETB TR0
LOOP2:  JNB TF0, LOOP2
        CLR TR0
        CLR TF0
        RET

DONE:   NOP
        END
```

Problem #5

Part A

$$2C_{16} + 11_{16} \implies 2C11_{16} \tag{6}$$
$$FFFF_{16} - 2C11_{16} + 1_{16} = D3EF_{16} \tag{7}$$
$$= 54254_{10} \tag{8}$$
$$\implies 58\,865.59\,\mu s \tag{9}$$
$$= 58.87\,\text{ms} \tag{10}$$

Part B

$$1001\,0011_2 \implies 93_{16} \implies 147_{10} \tag{11}$$
$$(65536 - 147) \times 1.085 = 70\,947.07\,\mu s \tag{12}$$
$$= 70.95\,\text{ms} \tag{13}$$