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B-TECH 3RD YEAR

MIT Tutorial 5

Ans 1:

i) No, the label LOOP1 is at the wrong line. It should be at line 5, instead of line 4. The program undergoes infinite loop.

ii) Instead of LOOP1 on line 4, it should have been on line 5.

iii) For finding the value of DELAY,

$$100 = 330 \times 10^{-9} \times (22 DELAY + (DELAY-1)10 + 7)$$

$$\Rightarrow 100 \times 10^{-3} = 330 \times 10^{-9}(32 DELAY - 3)$$

$$\Rightarrow \frac{100 \times 10^{-3}}{330 \times 10^{-9}} = 32 DELAY - 3$$

$$\Rightarrow DELAY = 9469.8 \approx 9469.8$$

iv) It adds 4 Tstates everytime LOOP1 is run. Also, it is used to OR the higher bits of DE pair with lower bits of DE pair.

v) No, it shouldn't be a part of LOOP2.

vi) No, it should be 000ah instead of 0010h.

vii) The 7 states for outer loop are:-
$$14 \times 10^{-3} + 10 \times 10$$
$$= \underline{137} + 10 \times 10$$
$$\underline{5237}$$

viii) No, there is no need for the instruction CPI, because DCR sets zero-flag if it results into 0.

ix) Yes, we need a HLT instruction to stop the program.

x) ~~When~~ Until B is reduced to 00h, it keeps on jumping to LOOP1.

xi) As given,

Delay by loop1 = 100ms.

Then,

total T states $= 14 \times 10 - 3 = 137$.

Total Delay $= 100ms \times 10 + 137 \times 330$ ns

$\approx 1s + 45.21 \mu s$

$\approx \underline{1s}$

xii) For keeping track of count of A, we can store it in B.C.

1.   MVI C, 64H

13. i)   ~~MOV A,~~ DCR C

13. ii)   MOV A, C.

xiii) Total T states between 2 Displays is given by :-

LOOP1 $= 32$ DELAY $- 3$

LOOP2 $= ($LOOP1 $+ 14) \times 10 - 3$

Total T-states $=$ LOOP1 $+ 21$

$= (32$ DELAY $- 3 + 14) \times 10 - 3$

$\approx$ ~~32~~ 320 DELAY $- ~~118~~ 227$

Delay $= \dfrac{320 \times 9470 - ~~118~~ \times 330 \, ns}{320}$

$\approx \underline{0.9999s}$

iv) No, it will not display 00 because it exist exits. Instead jump should have been done on MINUS

2) Clock time period = $\dfrac{1}{3.072}$ MHz = 325 ns

No. of T states required for 100ms delay

$= \dfrac{100 \times 10^{-3}}{325 \times 10^{-9}} = 3076.9 \approx 3077$

The code is as follows:-

```
              MVI
START:        Mov A, 00H          // Move 0 to A
DISPLAY:          Mov C, A        // Move C to A (store count)
              OUT   PORT1         // Display A
              LXI D, 24FEH        // Load 9470 to DE
LOOP 1:       DCX D
              NOP
              NOP
              MOV A, D
              ORA E
              JNZ LOOP1
              DCRA INRA INRC
              MOV A, C            // Move C to A
              INR A              // Increment A
              CPI 15H            // Compare with 21
              JC DISPLAY         // If less, jump to Display
              JMP START          // Jump to start if 0 to 20
                                    is printed.
```
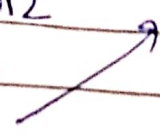
Ans 3:- Given,
clock time period = 325 ns
Required delay = 1.5 s.
We can set delay variable to 376E (14190) in question?

The code is as follows:-

```
                MVI  A,00h
DISPLAY:        MOV  C,A
                OUT  PORT1
                LXI  D,376E
LOOP1:          DCX  D
                NOP
                NOP
                MOV  A,D
                ORA  E
                JNZ  LOOP1
                MOV  A,C
                INR  C
                CPI  0AH
                JC  DISPLAY
                MVI  A,09h
DISPLAY2:       MOV  C,A
                OUT  PORT1
                LXI  D,376E
LOOP2:          DCX  D
                NOP
                NOP
                MOV  A,D
                JNZ  LOOP2
                MOV  A,C
                DCR  A

                        JMP  SKIP
                        JMP  EXIT
                SKIP:   JMP  DISPLAY2
                EXIT:   HLT
```

Delay Calculations:-

$$\text{Total } T_{states} = 14205$$
$$= 1490 \times (32) - 3$$

$$\text{Delay} = \left(1490 \times 32 - 3\right) 325 \text{ ns}$$

$$= \underline{150 \text{ ms}}$$