Spring 2023
EEE212 Microprocessors
Homework Assignment 2

06.04.2023 13:00 - 24.04.2023 13:00

In this homework assignment, you will work on the Timers interface for the 8051 microcontrollers. Please read the notes and the assignment requirements carefully since they are pretty important in terms of evaluation.

Important Notes:

- Your submission will be checked using **a Proteus simulation**. Thus, make sure that it works on a Proteus simulation.
- This is an individual assignment. You can cooperate but you have to submit your **OWN** code. Any kind of plagiarism will not be tolerated. Codes will be compared manually by assistants and by Turnitin software after the lab.
- The deadline is strict. Submit your code before the deadline.

Homework Assignment 2

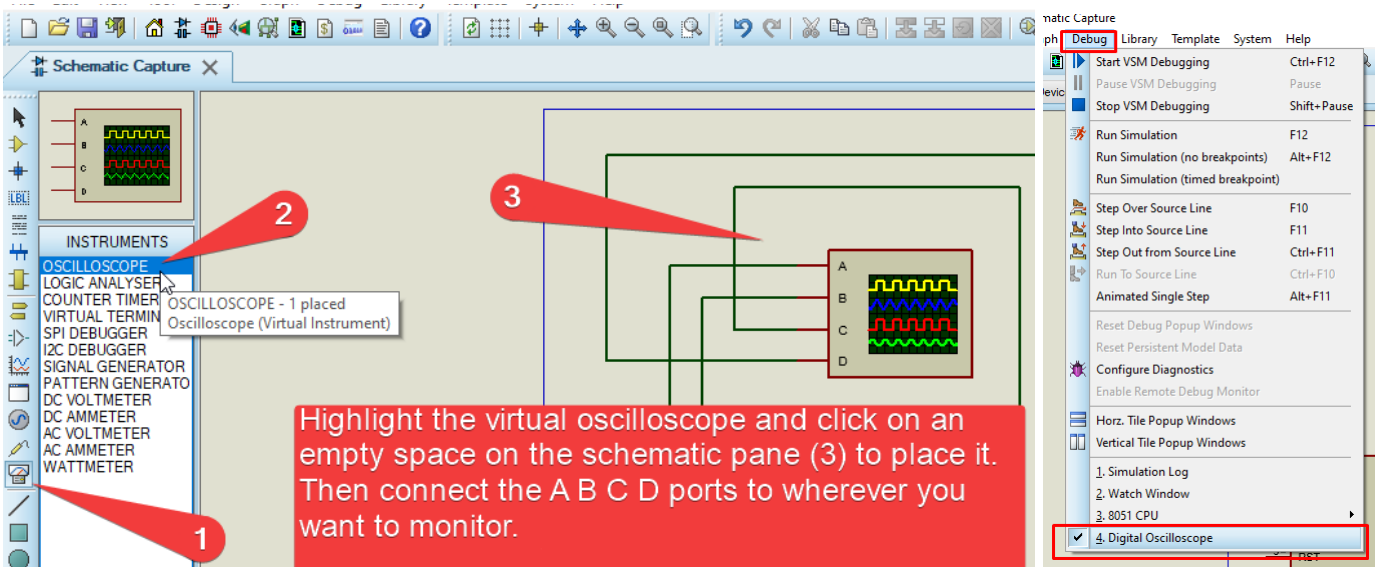
Note: You are NOT allowed to use delay subroutines in this assignment (except LCD & Keypad). Usage of those will result in 0 from that corresponding part. You have to use timers to create a delay.

- **[60 pts]** Upon start or reset of the microcontroller, you will enter a three-digit number N in the range [001,100] (i.e., N={001,002,003, …, 100}). Then the frequency of a square waveform (Waveform#1) must be set as f = N Hz. The LCD will display "f = f Hz" on the first line. Next, you will enter a two-digit number from the set D = {20, 30, 40, 50, 60, 70, 80}. D will be the duty cycle of the square wave. The LCD will display "D = D %" at the next line. Also, you will use another free pin to generate another square* waveform (Waveform#2). This second waveform's frequency should be triple the entered frequency f (saturate it at 255 Hz if $3f > 255$), and its duty cycle D should be half of the entered duty cycle. Generate these waveforms at available port pins. You will use Digital Virtual Oscilloscope in Proteus[1] to monitor your waveforms.

Waveforms	**Duty Cycle**	**Frequency (Hz)**
Waveform#1	Entered D	Entered f
Waveform#2	$D/2$	$3f$ if $3f \leq 255$ 255 if $3f > 255$

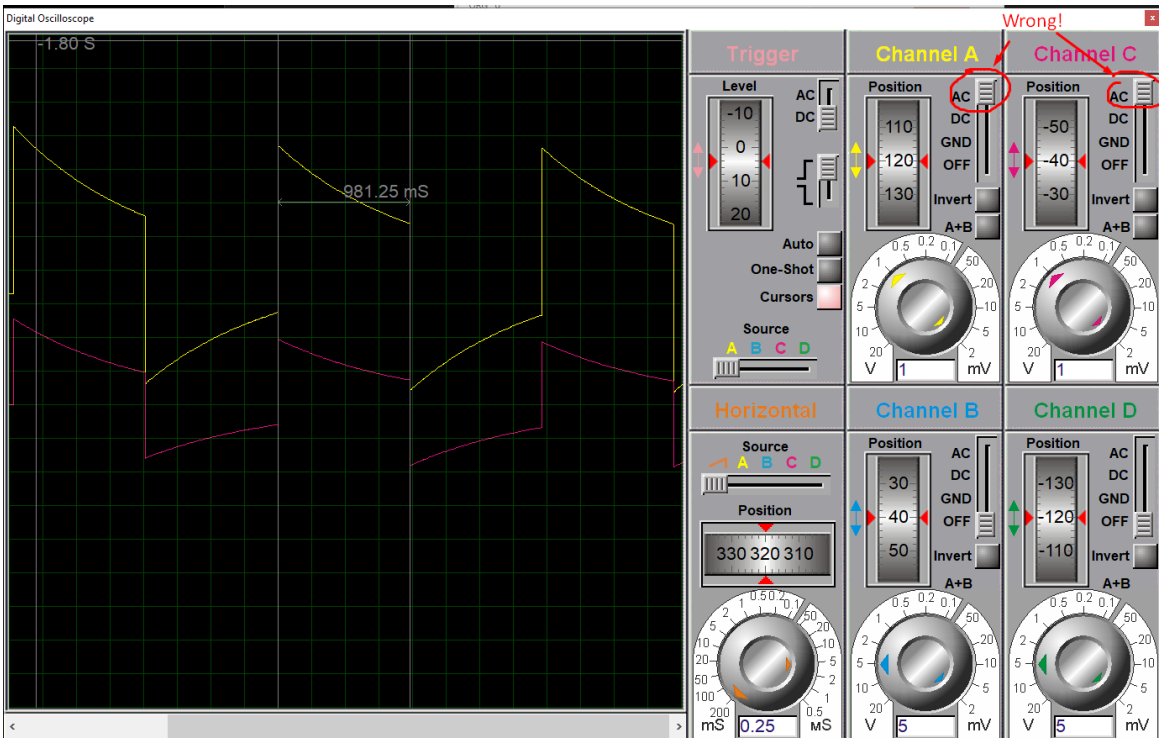
- **[40 pts]** In addition, display the state of the wave using a blinking LED[2] (simultaneously with the waveforms on the virtual oscilloscope). The frequency and duty cycle of the blinking should resemble Waveform#1. The duty cycles of the LED and the waveform must be equal. Use 1/20 of the frequency of the generated square wave Waveform#1(i.e., f/20) as the frequency of the blinking.

Note: [1]Digital Virtual Oscilloscope Instrument in Proteus. (click on the images for high-res pictures)

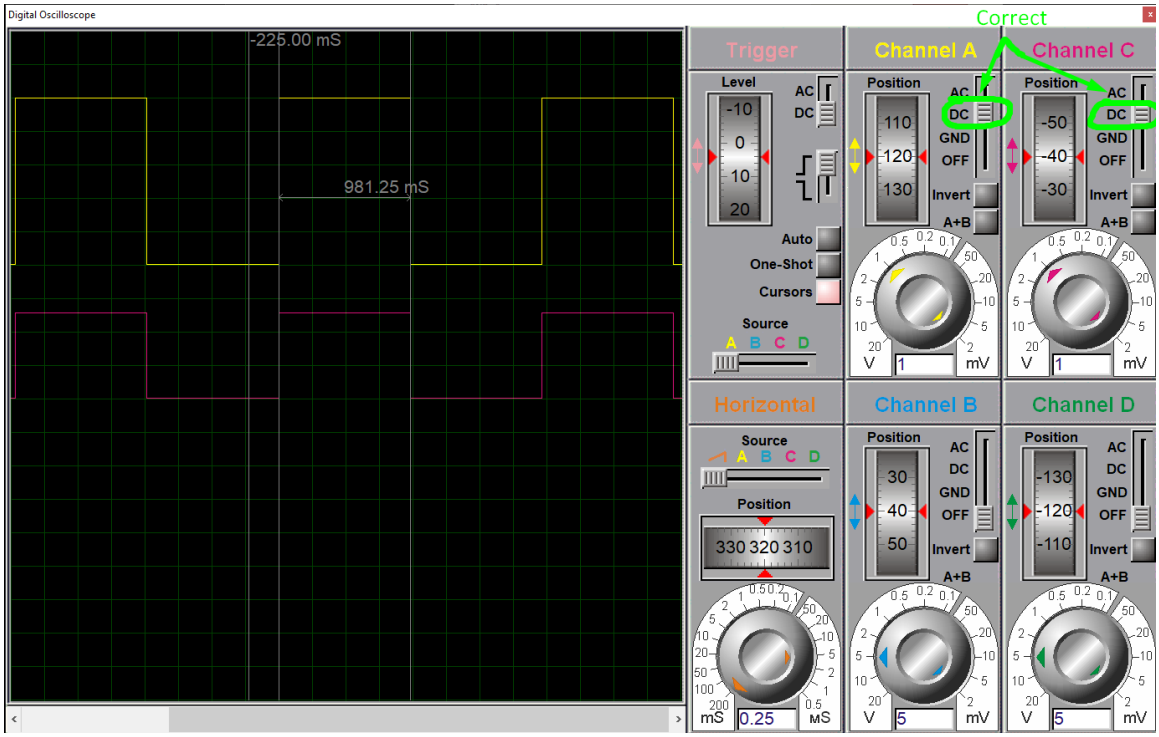


Note*: **About AC/DC Scope Coupling in Proteus:** For this homework, strictly **use DC coupling** on all channels. Otherwise, if left in AC coupling, the scope's internal "hidden DC-block capacitor" will try to block the low-frequencies that we are trying to generate and observe (explanation: link1 & link2 (@page 3-4 for the diagram)). (AC Coupled case example is the top figure on the next page: yellow: coupled to scope; red: coupled to both LED and the scope). The distortions happen when you leave the channels in AC coupling mode. (Example below is unrelated to the assignment's answer. It has two ≈0.5Hz, 50% square waves generated using Timer0 of the microprocessor, unloaded with LED vs loaded with LED).

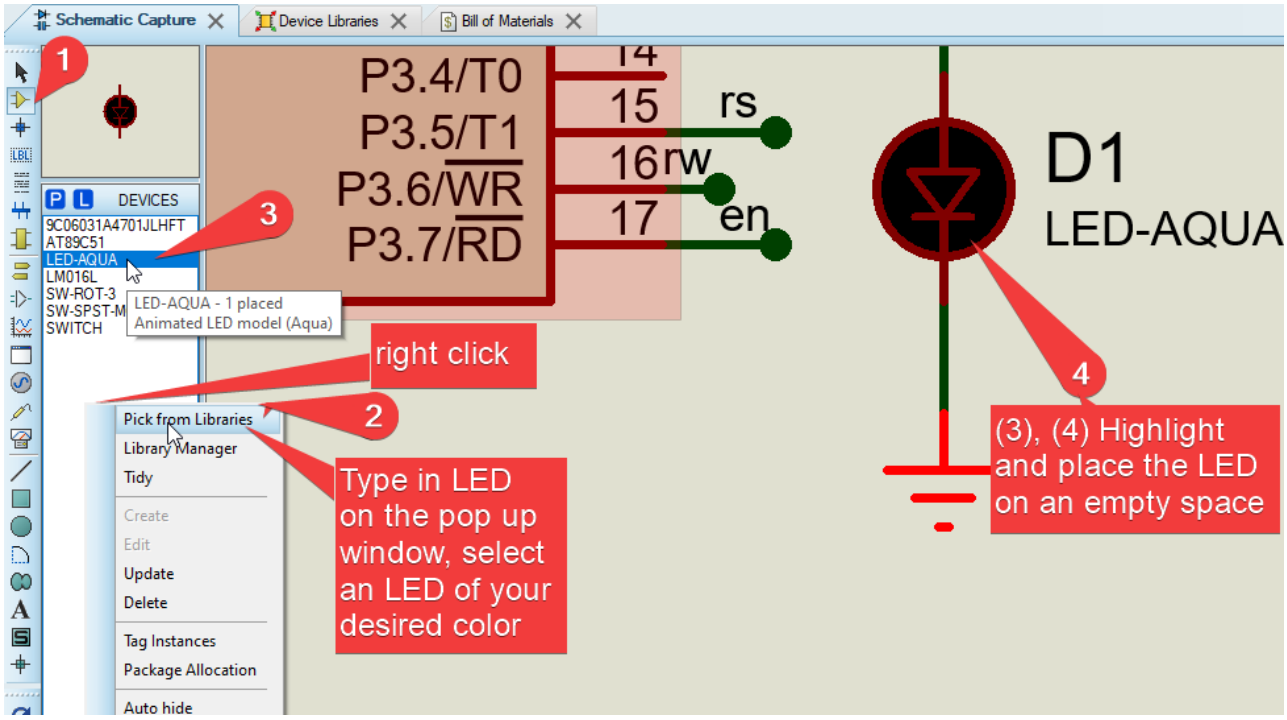
When AC coupling mode is used: (Test connections: https://i.imgur.com/WOoSlBv.png)



When DC coupling mode is used (correct): (Same test connections:)



Note: [2]LED in Proteus



Deductions:

- Values are not displayed on LCD: - 10 points
- Frequency is off by more than 5 Hz (but less than 10 Hz) in the worst case: -10 points
- Duty cycle is off by more than 5 percentage points (pp) (but less than 10 pp) in the worst case: -10 points