EEE 212 Spring 24/25 Lab 3

Due Date: 17.03.2025, 13:30

Please read the notes and the assignment requirements carefully since they are essential for evaluation.

Assignment Requirements

- Assignment requires timers, so please do not use delay subroutines. Using delay subroutines results in zero grade.
- The deadline is strict. Submit your code before the deadline. **You could not change your uploaded codes during lab. You will show your demos based on your uploaded codes**. You will not change even one line of the code during the demo.
- Your submission will be checked using a **Proteus** software during lab hours. **You are NOT given partial credit unless you show your work on Proteus (Demos on MCU 8051 IDE are not accepted)**. Thus, ensure it works on a Proteus before you come to lab hours.
- You need to get a check from one of the lab assistants. The check consists of small demonstrations and questions evaluating your knowledge of the lab. Indeed, note that getting a check from all parts does not mean you get the full grade. Your grade will also be based on your answers to questions and code efficiency.
- Please upload your codes files with '.txt'. TAs may run your codes after lab hours, so please upload the correct files. Please send two files respectively for different parts of the assignment. Failing to send the correct file results in a deduction of your grades.
- This is an individual assignment. You can cooperate but must submit your **OWN** code. Any plagiarism will not be tolerated. After the lab, the codes will be compared manually by assistants and by Turnitin software.

Part 1 (50 pts)

Upon start-up or reset of the microcontroller, you will enter a number N from the set $\{20, 40, \ldots, 100\}$. The period of the first square waveform (Waveform #1) must be set as $T = N$ ms. The LCD will display: "T = N ms" on the first line.

Next, you will enter a **two-digit number** from the set $D = \{10, 20, 30, \ldots, 90\}$. This number represents the duty cycle of the first waveform. The LCD will display: "Duty Cycle = D" on the second line. These LCD displays ensure that the entered values match the generated waveform observed on the oscilloscope.

Waveform Generation Rules

- **Waveform #1:**
  - The frequency is determined by the entered value T. Let the frequency of the first waveform f.
  - The duty cycle is D %.
- **Waveform #2:**
  - The frequency is the same as Waveform #1, i.e., f.
  - The duty cycle is $D/2$ % (half of Waveform #1's duty cycle).
- Generate these waveforms on available port pins (avoiding the pins used for the LCD and keypad in Proteus).
- Both waveforms must **continuously** operate based on the user inputs.
- You can either one timer or two different timers.
- The **Digital Virtual Oscilloscope** in Proteus must be used to verify the waveforms.

Summary Table

Waveform	Duty Cycle	Frequency
Waveform 1	D %	f Hz
Waveform 2	$D/2$ %	f Hz

Grading of Part 1

- Correctly generate one waveform (15 pts) with its correct frequency and duty cycle. You need to show that waveform is generated continuously, otherwise no points will be given. Errors up to 1% on both frequency and duty cycle are acceptable. For example, if your duty cycle is set to 30%

and the displayed value on the oscilloscope is 28.9%, no point deduction will occur, or if your frequency is set to 80 ms and the displayed value on the oscilloscope is 79.5 ms. Errors between 1% and 5% result in half of the grade being awarded, and errors greater than 5% but less than 10% result in a quarter of the grade being awarded.

- Correctly generate other waveform (30 pts) with its correct frequency and duty cycles in addition to first one. You need to show that waveform is generated continuously, otherwise no points will be given. Errors up to 1% on both frequency and duty cycle are acceptable. For example, if your duty cycle is set to 30% and the displayed value is 28.9%, no point deduction will occur. Errors between 1% and 5% result in half of the grade being awarded, and errors greater than 5% but less than 10% result in a quarter of the grade being awarded.
- Answer interview questions correctly. (5 pts).

Part 2 (50 pts)

This part is independent of the first part, so you will upload a separate file for this section. In this part, you will create a square waveform with varying frequencies and duty cycles.

- We will use the same set of values (f, D) from the first part. You will input these values using the keypad, as done in the previous section.
- Waveform 1 (with frequency f and duty cycle D) will be displayed for 2 seconds, then Waveform 2 (with frequency f and duty cycle $D/2$) will be displayed for 1 second. This process will repeat continuously.
- Unlike in Part 1, where Waveform 1 and Waveform 2 were displayed on different pins, in this section, a single waveform will be generated that alternates between these duty cycles and frequencies over time.
- Let the x-axis represent time. The waveform should exhibit the following pattern:

	(2 sec)	(1 sec)	(2 sec)	(1 sec)	...
Waveform	f, D	$f, D/2$	f, D	$f, D/2$	...

Grading of Part 2

- Correctly generate the first part of the waveform and pass to the other within 2 seconds (20 pts). You will not get any points if you do not correctly pass to the second waveform, i.e, you need to alternate to the other part of waveform visibly. The error bands are the same as the previous part, with the same rules applied to the 2-second passing time.

- Correctly generate the first part of the waveform and pass to the other within 1 second (20 pts). You will not get any points if you do not correctly pass to the other waveform, i.e, you need to alternate to the other part of waveform visibly. The error bands are the same as the previous part, with the same rules applied to the 1-second passing time.
- Answer interview questions correctly. (10 pts).

Additional Information

Note: Digital Virtual Oscilloscope Instrument in Proteus, check Figure 1 for how to add this to your Proteus project.

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 (for detailed explanation: link1. link2.). In summary, the distortions happen when you leave the channels in AC coupling mode; please check Figure 2 and Figure 4 for illustration.

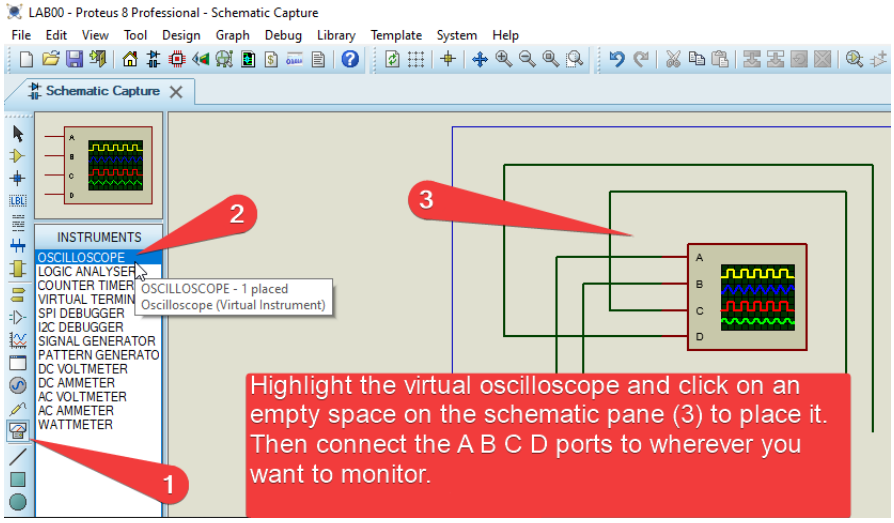

Figure 1: How to add Digital Virtual Oscilloscope to your Proteus projects. You can check the video[[1].

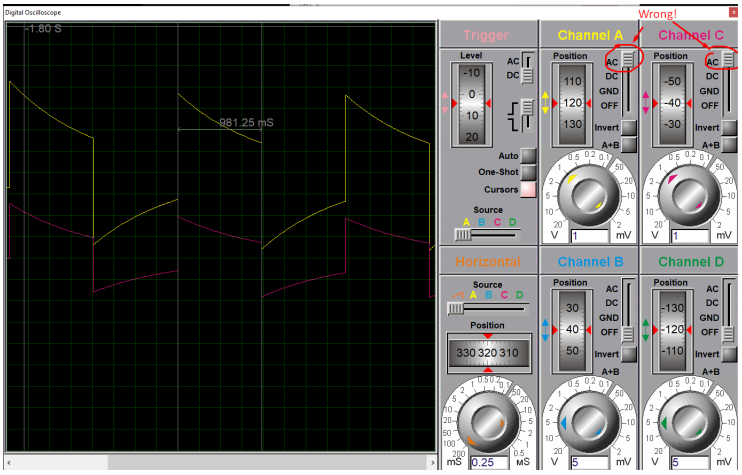

Figure 2: When AC coupling mode is used. As seen, the signal is distorted.

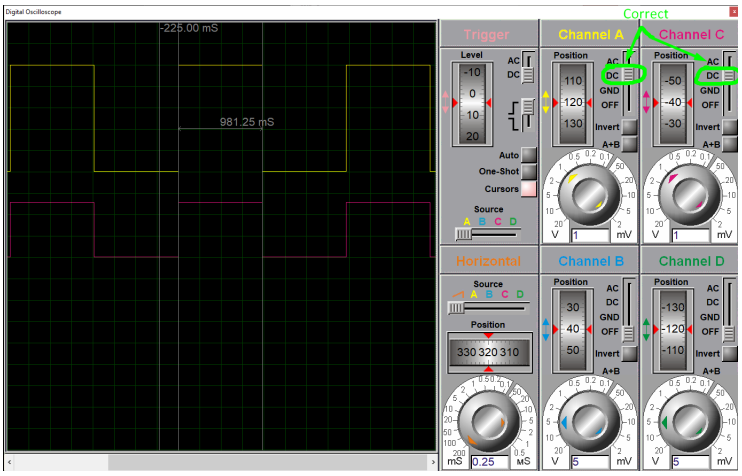

Figure 3: When DC coupling mode is used. As seen, we observe the square wave correctly.

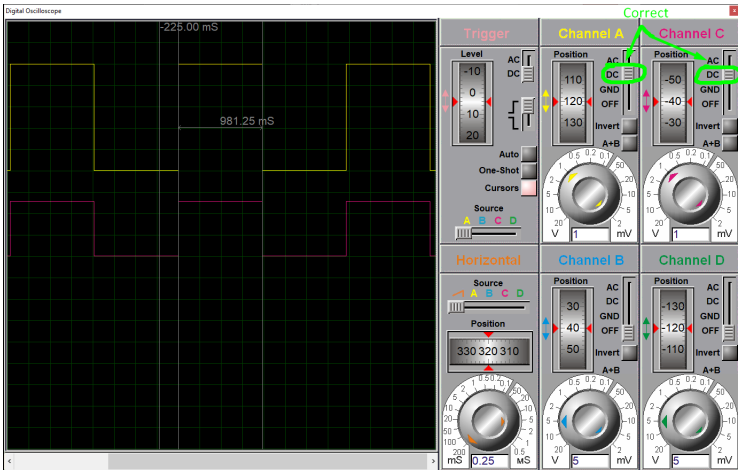

Figure 4: When DC coupling mode is used. As seen, we observe the square wave correctly.