In this lab, you will be learning about Universal Asynchronous Receiver-Transmitter (UART), which is a serial communication hardware. Refer to Prof. Dinesh Sharma's slides and notes on UART given here-https://ee337.github.io/dks.html#serial-io

- 1. [20 points] In this question, you will understand communicating between Pt-51 and a computer using UART. You need to send values from Pt-51 board to your computer, display those values on your computer and store it in a file.
 - i) To connect the kit to a computer, you will be using the USB-to-UART adapter Prolific PL2303 (Figure 1) that is part of the kit. The driver software for this adapter and the instructions for installing it can be found at the following link: http://www.miklor.com/COM/UV_Drivers.php

After installing the software, connect the PL2303 adapter to one of the USB ports of your PC.



Figure 1: USB to UART adapter.

- ii) Connect the Pt-51 kit to the USB-to-UART adapter using F-F wires as described next. In the Pt-51 kit, port pin P3.0 is the serial data input and P3.1 is the serial data output. Connect P3.0 of the kit to transmit data line (TxD) of the adapter. Connect P3.1 of the kit to receive data line (RxD) of the adapter. Connect the GND pin of the kit to GND pin of adapter.
- iii) For recognizing inputs from the board and capturing to text file in PC through the serial terminal, you need to use the Realterm software (or any equivalent software). This software will also be used to display the messages received from the Pt-51 kit on the PC. A screenshot of Realterm window is shown in Figure 2.

For Windows, download Realterm at: https://realterm.i2cchip.com For Linux, you can download Putty.

🏝 RealTerm:	Serial Capture Progra	m 2.0.0.57			_ 🗆 🔀
5 1 736400					
Display Port Display As C Ascii C Ansi C Hex[space] C Hex + Ascii C unt8 C Int8 C Hex C int8 C Int8 C Int6 C Ascii C Int7 C Ascii C Int8 C Hex Float4	Capture Pins Send Half Duplex newLine mode Invert Data Big Endian Data Frames Bytes 2 Single Gulp Rows Terminal Font 16 16	Echo Port 12C 12C- Binary Sync Chars ABCD Cols Cols Scrollba	2 I2CMisc Misc Data Sync is: XOR ASC AND Num Leading S ck	ne CII nber Sync	Image: Clear Freeze Status Status Connected RXD (2) TXD (3) CTS (8) DCD (1) DSR (6) Ring (9) BREAK Error
Ctrl+Tab to step th	rough tab sheets		Char Count:0000000	CPS:0	Port: 1 57600 8N1 None

Figure 2: RealTerm: Serial/TCP Terminal

iv) Configure Realterm (or equivalent tool) to use the appropriate COM port and baud rate. This can be done by clicking on Serial Port/Port tab and choosing appropriate COM port as the port to which the USB-to-UART adapter is connected. Set the baud rate to 4800 (the baud rate you have used in your program). Then click on Open. A screenshot of Realterm window with port and baudrate setting is shown in Figure 3.

Display Port Capture Pins Send Echo Po	t I2C I2C-2 I2CMem I2CMisc Misc	\n Clear Freeze ?
Baud 4800 $Port 9 = ProlificSerial0$ Parity Data Bits Stop Bits \bigcirc None \bigcirc 8 bits \bigcirc 1 bit 2 bits \bigcirc Odd \bigcirc 7 bits Hardware Flow Control \bigcirc Mark \bigcirc 6 bits \bigcirc None \bigcirc RTS/C \bigcirc Space \bigcirc 5 bits \bigcirc DTR/DSR \bigcirc RS485	✓ Open Spy ✓ Change Software Flow Control Receive Xon Char: 17 Transmit Xoff Char: 19 Winsock is: O Raw ● Telnet	Status Disconnect RXD (2) TXD (3) CTS (8) DCD (1) DSR (6) Ring (9) BREAK Error USB

Figure 3: RealTerm: Baudrate

v) Use the same setup designed in previous lab to read sinusoidal signal from AFG onto Pt-51 board using SPI protocol. With the setup connected to the computer using the USB-to-UART adapter, you will use it to get the digitized input printed on LCD to display it on the computer.

Use main.c as starting (template) code. This uses serial.c and lcd.h for initialisation of UART and LCD, respectively. These files are present in Lab10_UART folder.

The flow of the program is given below.

- 1. Complete the function uart_init() in serial.c to configure the serial port for UART communication. Use timer T1 and a baud rate of 4800 bps.
- 2. Capture the values sent to the computer via UART using real term serial capture. Refer to Figure 4 to capture the values and save them in a text file. "Start Overwrite" will start saving the values printed on RealTerm to the text file (path specified). "Stop Capture" will stop saving the values.

🔁 RealTerm: Serial Capture Program 2.0.0.57		-	
00045 GLF 00096 GLF 00170 GLF 00264 GLF 00377 GLF 00503 GLF 00599 GLF 00799 GLF 00964 GLF 01135 GLF 01316 GLF 01316 GLF 01493 GLF 01674 GLF 01674 GLF 01691 GLF 0170 GLF 0092 GLF 0094 GLF 0094 GLF 0094 GLF 0095 GLF 015 GLF			
Uisplau Port : UdUUIE Pins Send Echo Port 121	L I2C-2 L I2CMise L Mise L	\n Clear	Freeze
Display Port Capture Gapture Start: Overwrite Start: Append Stop Capture Eile C:\Users\Pankaj\Desktop\capture_data.txt Capture as Hex TimeStamp Outling Outling	I2C-2 I2CMisc Misc End After ● ● ③ Bytes 0000000 ↓ ○ Secs ● Direct Capture ✓ ○ Matlab ○ YMDHS ○ space	\n Clear Diagnostic Files Log hex Irace hex Clear Dump File realterm.log ▼	Status Disconnect RXD (2) TXD (3) CTS (8) DCD (1) DSR (6) Ring (9) BREAK Error

Figure 4: RealTerm: Serial/TCP Terminal

3. Plot the saved values using Python (or some plotting tool). You should be able to observe a sinusoidal wave. Note : The y-axis should be value and x-axis should be sample index.

TA Checkpoints

- 1. Check whether students have captured the input from board to the text file and all values are obtained properly.
- 2. Check whether students have plotted the sinusoidal wave output.