FALL 2022/ECE4144 EXAM 2 (Open book, notes and Laptop)

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Bioimpedance spectroscopy has been used for medical applications for almost a century. The technology is based on injecting a small sinusoidal current through tissue by way of two electrodes, and then measuring the phasor voltage across those same electrodes. The ratio of phasor voltage to phasor current is impedance, which indeed is a function of frequency. Evaluating the impedance across a range of frequencies can help characterize tissue as benign or cancerous.

Analog Devices makes a chip sensor that is designed to make these measurements. It is the AD5933 (Datasheet attached). This chip provides two terminals that can be attached to tissue through which a small current can be passed and a voltage measurement can be made. You are tasked with building a partial driver for this chip. The objective of this exam is to connect to the AD5933 chip and retrieve the temperature value (in deg Celsius). We also wish to capture the I2C interrupt and toggle the onboard LED every time a data byte is transferred and an ack is received.

1. Read the relevant parts of attached datasheet to familiarize yourself to the device. Specifically focus on the serial communications part (pages 27-29), the register information (pages 23-26), and the temperature status (page 16).
2. Using the pin diagram on Page 8, sketch a schematic that connects you Adafruit Classic I2C bus to the correct pins on the AD5933. Don't forget pull up resistors.
3. Start a new project in PlatformIO, chose your Adafruit Classic, and select Arduino framework.
4. Write the setup code to:
    a. Write the TWCR register to enable the I2C bus and enable the I2C interrupt. (See 32U4 datasheet for TWCR details)
    b. Configure the onboard LED (Red) as an output to control the LED. Do this by setting the correct DDR register.
    c. Start the Serial bus so that we can display the temperature in the serial terminal.
5. Write a function called GetTemp() that communicates I2C to the chip and retrieves (and returns) the temperature in degrees Celsius. MAKE SURE YOU READ PAGES 28-29 OF THE AD5933 DATASHEET. You can use the Wire Library functions (Wire - Arduino Reference)
6. Write the ISR for the I2C Interrupt.
    a. This interrupt should do the following:
        i. Check the value of the TWSR register
        ii. If that register indicates that a data byte was transmitted with an ack, toggle the onboard red LED. See table 20-2 in your 32U4 datasheet for details on the TWSR register.
        iii. Clear the TWINT flag in the TWCR register.
7. Write the loop() function to poll for the temperature once per second and display the temperature on the serial terminal. You can use delay() for this part.
8. Submit 2 files, your schematic and your code file (with comments please!)
   Good luck!