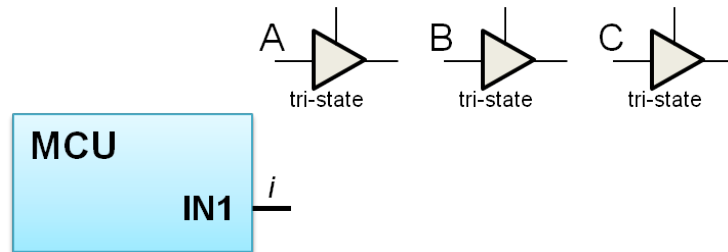


Due April 15 at the beginning of class.

- Complete the schematic below for a microcontroller-based system that will allow 3 digital signals (named **A**, **B**, **C**) to share a single microcontroller input line (named **IN1**). Include 3 tri-state buffers assuming only one of their select (enable) inputs (named **sA**, **sB**, **sC**) can be active (high) at any given time. Include appropriate circuit elements to ensure $IN1=0$ when all 3 tri-state buffers are disabled. The functionality to be implemented is defined by the truth table below:

sA	sB	sC	IN1
0	0	0	0
1	0	0	A
0	1	0	B
1	0	1	C

Starter schematic:



- Your boss has asked you to design a data acquisition system with an A/D converter to monitor an analog signal with information content between 100mHz and 30kHz.
 - What is the minimum frequency at which you should sample the analog signal?
 - Your boss tells you to include a filter to prevent aliasing from the sampling process. What type of filter (low pass, high pass, band pas) and what cutoff frequency should you choose?
- Consider an A/D converter with a reference low at ground and a reference high of 3.3V.
 - What is the resolution (in mV) if this is a 10-bit A/D?
 - What is the resolution (in μV) if this is a 12-bit A/D?
- Consider a 10-bit A/D with $V_{RH} = 2.1\text{V}$ and $V_{RL} = 0.4\text{V}$. What analog value is represented by A/D digital output of $52B$?
- What digital value (in hexadecimal) is read by a 16-bit A/D for a sensor input of 2.48V. Assume the A/D is referenced to 0.5V and 5.5V and truncates results so that any voltage between steps is assigned the value of the lower step.
- In a serial communication system
 - What is the function of a parity bit?
 - What is the value of the parity bit for an EVEN parity check of data value $99E$?
- Sketch the data signal (TxD) as a function of time for a UART (SCI) sending a value of $5A5$. Assume there is no parity bit, but include start (0) and stop (1) bits.
- List at least two similarities, using serial communication terms, between SPI and I^2C .
- For the following serial communication standards, list the typical signal names (using standard acronyms) found in the interface.
 - SPI
 - UART
 - I^2C
- Your boss has asked you to connect six digital peripheral devices to a microcontroller. The peripheral devices have synchronous serial inputs and outputs, and each has a device enable/select pin. You have decided to complete this task using the SPI interface and a general purpose I/O port. List the signals, using standard SPI acronyms, in the bus between the microcontroller and the six peripheral devices. How many total signals are needed?