

**Quiz2, open book, Thursday 4/4, 12:30 to 1:45 pm, in class.** Open book, open notes. No electronic devices (laptop, calculator, phones, devices with wireless communication). I recommend some crib notes based on the following PowerPoint slides. You are allowed to use the textbook, but it will not be required. The exam is not a search and rescue effort, but a think about and understand basic concepts. You will not be allowed to communicate in any way with other students. Any starter code or datasheet you need, I will provide. I recommend that write in your book/notes and place tabs on the pages to help you find things quickly (e.g., SSI timing, ADC registers, ADC parameters, fixed-point definitions, and timer registers and examples, analog circuits.)

**You will not be allowed to call any TivaWare functions.** You can use the standard I/O port definitions as found in the book and tm4c123gh6pm.h. I expect you to be able to initialize and use

- parallel ports (all of Table 4.2)
- periodic SysTick interrupts, periodic timer interrupts,
- edge-triggered interrupts,
- SSI busy-wait,
- ADC software start, multiple channel, busy-wait, ADC timer triggering
- No PWM or input capture (on lab 10, and final)

### STUDY GUIDE for Quiz 2 (Quiz 1 stuff plus the following)

#### Lec Topics

- aLec17 DAC techniques, Sampling, Nyquist, Frequency resolution
- aLec18 SPI, timing diagrams
- aLec19 Sound, DAC figure of merit, analyzing spectrums, SNR
- aLec20 Audio amp, SNR, analyzing gain versus frequency for an analog filter
- aLec21 DAC, range resolution, precision, monotonicity, student's t-test, resistor string
- aLec22 Power budget, requirements document
- aLec27 Power budget, batteries, Regulators: linear, buck, boost, buck-boost
- aLec29 E24 resistors, tantalum vs ceramic capacitors, ESR, ESL
- aLec33 Transducers, sensitivity, selectivity, precision, accuracy, SNR, frequency response
- aLec34 Op amps, rail-to-rail, linear circuits
- aLec35 Nonlinear op amp circuits, hysteresis
- aLec49c DFT, frequency resolution, is there aliasing?

#### Lab Important Topics

- 5 DAC, SSI, interrupts, data structures, audio amp
- 6 Power, systems organization
- 7,8 I/O interfacing
- 9 Sampling, audio input, ADC, analog circuits, filter analysis, measurements, noise, FFT
- Capacitance xyz  $C=xy \cdot 10^z \text{ pF}$  :  $105 \cdot 10^5 \text{ pF} = 1 \mu\text{F}$
- ADC techniques
  - Successive approx.: accurate, low cost
  - Flash : fast;  $\text{cost}=2^n$
  - Sigma-delta: Most precise

#### Lab 5 reading

- Valvano Section 4.2 on timing diagrams
- Valvano Section 4.5 on edge-triggered input
- Valvano Section 4.6 on output modes
- Valvano Chapter 5 on interrupts (SysTick periodic, edge-triggered, and timer periodic)
- Valvano Section 8.4.1 on DAC parameters
- Valvano Section 8.4.2 on waveform generation
- Valvano Section 7.5 on SSI

#### Lab 7 review

- Figure 1.14 on capacitance
- Section 9.2 LM2937-3.3 and LP2950-3.3 (capacitors, dropout voltage, output voltage, input voltage)

#### Lab 9 reading

- Valvano Section 8.1 on resistors and capacitors
- Valvano Section 8.2 on op amps, instrumentation amp, circuit design, and threshold detector
- ~~Valvano Section 8.3 on analog filter design~~

Valvano Section 8.5 on ADC

~~Valvano Section 10.1 on Data Acquisition Systems~~

Valvano Section 10.2 on Transducers

Valvano Section 10.4 on Nyquist Theory, precision

Valvano Section 10.5 on DAS design

*Please look at the old exams, but don't just study these exams.*

### SSI interfacing

Fall 2012 Quiz 2, Question 2, Bit-bang SSI output (making SSI signals with GPIO port)

Fall 2014 Quiz2, Question 3, SPI timing, set up and hold, timing diagrams

Fall 2015 Quiz2, Question 3, SPI mode, hardware FIFO buffering

Fall 2016 Quiz 2, Question 3, Bit-bang SSI output (making SSI signals with GPIO port)

Spring 2017 Quiz2, Question 3, SPI initialization (DSS, SPO SPH)

Spring 2018 Quiz2, Question 5, SPI initialization (DSS, SPO SPH), what is the data?

Fall 2018 Quiz2, Question 3, SPI initialization (DSS, SPO SPH), what is the data?

Fall 2019 Quiz2, Question 3, SPI initialization

Spring 2023 Quiz2, Question 1, SPI interface with timing diagrams

### Analog interfacing

Fall 2012 Quiz 2, Question 3, Data acquisition design

Fall 2012 Quiz 2, Question 4, Resolution versus accuracy

Fall 2012 Quiz 2, Question 6, Analog amplifier

~~Fall 2014 Quiz 2, Question 5, Low-pass analog filter, Butterworth 2-pole filter~~

Fall 2014 Quiz 2, Question 7, Analog amplifier

Fall 2015 Quiz 2, Question 2, Sampling, DFT, frequency resolution

Fall 2015 Quiz 2, Question 5, Gain versus frequency of RC HPF circuit

~~Fall 2015 Quiz 2, Question 7, Instrumentation amp~~

Fall 2016 Quiz 2, Question 2, Resolution versus accuracy

Fall 2016 Quiz 2, Question 6, Gain versus frequency of BPF circuit

Fall 2016 Quiz 2, Question 7, Analog amplifier

Spring 2017 Quiz 2, Question 4, Sampling, DFT, frequency resolution

Spring 2017 Quiz 2, Question 6, Analog amplifier (transducer interface)

Spring 2018 Quiz2, Question 6, Sampling, DFT, SNR

Spring 2018 Quiz2, Question 7, Analog amplifier

~~Fall 2018 Quiz2, Question 4, ADC0\_PC\_R~~

Fall 2018 Quiz2, Question 5, Central Limit Theorem

~~Fall 2018 Quiz2, Question 7, ADC sequencer~~

Fall 2018 Quiz2, Question 8, ADC resolution

~~Fall 2018 Quiz2, Question 9, Analog amplifier with instrumentation amp~~

Fall 2018 Quiz2, Question 10, Analog amplifier with op amp

Fall 2019 Quiz2, Question 5, Sampling jitter

Fall 2019 Quiz2, Question 6, Sampling, DFT, SNR, aliasing

Fall 2019 Quiz2, Question 7, Analog amplifier

Fall 2019 Quiz2, Question 8, Shunt diode

Spring 2023 Quiz2, Question 3, Transducer interface, and fixed point

### Fixed Point

Fall 2012 Quiz 2, Question 5, Binary fixed-point

Fall 2014 Quiz 2, Question 6, Decimal fixed-point

Fall 2015 Quiz 2, Question 6, Decimal fixed-point, prevent overflow

Fall 2016 Quiz 2, Question 6, Decimal fixed-point

Spring 2017 Quiz 2, Question 2, Fixed-point math

Spring 2017 Quiz 2, Question 5, Fixed-point equation

Spring 2018 Quiz2, Question 4, Fixed-point equation

Fall 2018 Quiz2, Question 6, Fixed-point add multiply, divide functions

Fall 2019 Quiz2, Question 4, Fixed-point design

**Interrupt programming concepts and implementations**

- Fall 2012 Quiz 2, Question 7, Edge-trigger interrupts
- Fall 2014 Quiz 2, Question 2, Busy-wait versus interrupt
- Fall 2014 Quiz 2, Question 4, Edge-trigger interrupts, priority
- Fall 2014 Quiz 2, Question 8, Timer interrupts, input capture
- Fall 2015 Quiz 2, Question 4, Edge-trigger interrupts, priority
- Fall 2016 Quiz 2, Question 5, Timer-triggered ADC interrupts
- Spring 2017 Quiz 2, Question 7, Edge-trigger interrupts, brush-less DC motor interface
- Spring 2018 Quiz2, Question 8, Edge-trigger interrupts
- Fall 2018 Quiz2, Question 2, Edge-trigger interrupts
- ~~Fall 2019 Quiz2, Question 9, Input capture interrupts~~
- Spring 2023 Quiz2, Question 2, GPIO edge detection using periodic interrupts

**Systems and interfacing**

- Fall 2012 Quiz2, Question 1, Regulator
- Fall 2014 Quiz2, Question 1, Regulator
- Fall 2015 Quiz2, Question 1, Regulator
- Fall 2016 Quiz2, Question 1, Regulator
- Spring 2017 Quiz2, Question 1, Regulator
- Spring 2018 Quiz2, Question 1,2,3, Regulator
- Fall 2018 Quiz2, Question 1, Regulator
- Fall 2019 Quiz2, Question 1, Regulator
- Fall 2019 Quiz2, Question 2, PN2222
- Spring 2023 Quiz2, Question 4, Recognition of capacitor type by shape
- Spring 2023 Quiz2, Question 5, Determine value of ceramic capacitor by marking.
- Spring 2023 Quiz2, Question 6, Estimate battery life.