Quiz 1: ECEC-T580: Computing and Control
Spring 2019-20

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Instructions: For those taking exam in class

1) Open notes and access to project memos or project info and internet
2) You must perform the work by yourself. – NOT A GROUP EXAM

Statement of Understanding:

I, ______Tai D Nguyen______________________, testify that this submitted work is mine and mine only without violating the university's academic honesty standards.

______Tai D Nguyen, 05/10/2020_____
(sign &date)

Answer the following questions appropriately by circling or writing in answers. Each question is 2 points.

Ques #	Question
1	The Arduino Mega 2560 has a native: a) Floating point processor b) 16 bit processor c) 8 bit processor
2	On the Mega2560 only an internal timer can be used to trigger an interrupt. a) True b) False
3	The Mega2560 is based on the Advanced Virtual RISC by ATML. Which of the following is not explicitly defined in the AVR architecture? a) Memory b) CPU c) ADC d) DAC e) USART/UART f) Timers g) binary I/O
4	Which **2 statements** are true about signal to quantization noise ratio, SQNR? a) It is the ratio of the signal voltage to the noise voltage. b) It is the ratio of the signal power to the noise power. c) It is the ratio of the noise voltage to the signal voltage. d) It is the ratio of the noise power to the signal power. e) The larger SQNR value the better. f) The smaller SQNR value the better.
5	If the frequency of an input sign wave exceeds the Nyquist sampling rate, what should we expect when we reconstruct the signal a. The output to be a constant b. The output to be a constant square wave c. The output to have a different frequency than the input d. The quantization steps to be different widths but heights are as expected

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	Note probs 6 and 7 are related
6	It is desired to multiply two fixed point numbers together. The first number is 5.5 and the second number is 6. 125. Represent the first number as W(8, 5,2) and the second as W(8,5,3) both numbers in binary and show binary point and indicate sign bit 5.5 as W(8,5,2): s=0, whole=00101, frac=10 => 000101.10 6.125 as W(8, 4,3): s=0, whole=0110, frac=001 => 00110.001
7	Represent the product of 5.5 and 6.125 as a 16 bit number showing the binary point, and sign bit and then use format W(x,y,z) to define result Binary result: 00000100001.10110 (s=0) W notation: W(16,9,5)
8	Write the state position update equation for the alpha filter (version of Kalman filter). Remember α *and* $P(k\|k)$ are constants. Identify terms. $$\hat{x}_{k+1\|k+1} = \hat{x}_{k\|k} + \alpha(z(k+1) - \hat{x}_{k\|k})$$ x_hat(k+1|k+1) is the new estimate, x_hat(k|k) is the previous estimate, alpha is a constant, z(k+1) is the new measurement.
9	Consider the HC-SR04 Ultrasonic Ranging Sensor. Provide an approximate formula that converts the received echo signal to inches. Take temperature into account but disregard or humidity. Use 70 degrees F as the operating temperature. distance = duration*0.5*(0.03314 + 0.00006*T)*(1/2.54) T is temperature in Celcius.
10	Given the state space representation of a Low Pass Filter with input u(t) and output y(t) : $\frac{dy}{dt} = a\, y(y) + au(t)$ where $A \epsilon R^{+}$of course a is the pole or break frequency. Assuming that the sample time is **T**, which of the following recursive equations implement the system exactly, i.e. y(kT) = y[k] with **u(kT)** being piecewise constant and $k \epsilon \mathbb{Z}$ is the discrete time index. a) $y[k+1] = (1 - aT)y[k] + aTu[k]$ b) $y[k+1] = (1 + aT)y[k] + aTu[k]$ c) $y[k+1] = e^{aT}y[k] + (\frac{e^{aT}-1}{a})\ u[k]$ d) $y[k+1] = e^{aT}y[k] + (e^{aT} - 1)u[k]$ e) Correct answer not given This filter is a single-pole IIR filter that applies weighting factors which decrease exponentially. Hence, the equation is a) should give this characteristic.