Description of Assignment

Please complete this chapter quiz without help from another student. Do not share answers either. If someone contacts you and says they need help on a certain problem, please just tell them that you cannot help them or discuss this quiz at all. Do not share code. Do not share information. Do not share hints. Do not talk to them about this quiz. You cannot contact me to get help on the problems. If you are unsure of whether or not you can use something just fall back to the following statement: "***You may not contact another human being for help on this quiz. If the answer is on the internet then it is fair game".***

Therefore, you are on your own to find the answers or just infer some assumptions from any lack of information. The answers are there, you just need to go find them. Zoom lectures, youtube videos, and documentation like Wikipedia, etc are all valid sources of information.

This quiz will be distributed to you and due within one week. Due to the fact that this assignment is an assessment of your performance and timeliness is part of that assessment, no late assessments will be accepted. My recommendation is for you to turn in the assignment at least an hour early so you don't run into any technical problems.

Submission Checklist - SEND EVERYTHING VIA EMAIL

1.) Name on document
2.) Digitally signed document
3.) Converted to a SINGLE PDF
4.) All python scripts imbedded in document either as screenshots (not cell phone photos) or text
5.) Results from computer software is included as a figure with properly labeled axes
6.) References section included

Honor Pledge

I, *Justin Dyer*, have read the description above and acknowledge that I did not contact another human being whether digitally or face to face to receive or give help on this quiz. I acknowledge that the answers below are in my own words and reflect my understanding of the material.

Signiture: _____

DATE: ___/___/_____

1.) My graduate student 3D printed a wheel with 12 spokes on it each equidistant from each other. He created code to measure the angular velocity based on the time between successive measurements using a light sensor as each spoke passes over the sensor. First draw a picture of this tachometer and then explain how you would compute the angular velocity of the wheel.

TABLE 9.3 Platinum RTD: R Versus T (U.S. Calibration)[a]

T (°C)	$R(\Omega)$	T (°C)	$R(\Omega)$	T (°C)	$R(\Omega)$
−100	59.57	100	139.16	300	213.92
−90	63.68	110	143.01	310	217.54
−80	67.78	120	146.85	320	221.14
−70	71.85	130	150.68	330	224.74
−60	75.91	140	154.49	340	228.32
−50	79.96	150	158.29	350	231.89
−40	83.99	160	162.08	360	235.44
−30	88.01	170	165.86	370	238.99
−20	92.02	180	169.63	380	242.52
−10	96.01	190	173.39	390	246.05
0	100.00	200	177.13	400	249.56
10	103.97	210	180.86		
20	107.93	220	184.58		
30	111.87	230	188.29		
40	115.81	240	191.99		
50	119.73	250	195.67		
60	123.64	260	199.35		
70	127.54	270	203.01		
80	131.42	280	206.66		
90	135.30	290	210.30		

[a] $R = 100\ \Omega$ at 0°C.

2.) Look at the figure above for RTD devices. Since this is a Google Doc you can make that Figure bigger if you have a hard time reading it. Plot temperature on the x-axis and the resistance in Ohms on the y-axis. Is it linear? Assume you measure the resistance in the Ohms to be 129 Ohms. According to the table, what would be the temperature in C? Plot that single data point on your graph as well. The resistance data is in plain text on the last page of this document and the temperature is just in intervals of 10C so you can just use numpy.arange().

3.) The MPXV5010DP pressure transducer measures differential pressure in a pitot probe. The reference voltage (delta pressure = 0) is 2.5V. Assume that you measure a voltage of V = 2.51 which is not a large change in voltage. What would be the computed windspeed from the pitot probe sense. Note that density is 1.225 kg/m^3 at sea-level in SI units.

$$_{\Delta}V = V - 2.5$$
$$_{\Delta}P = 1000\Delta V$$
$$U = \sqrt{(2\Delta P/\rho}$$

4.) This question deals with an IMU
    a.) What is an IMU?
    b.) What does IMU stand for?
    c.) What sensors make up an IMU and how do they work?
    d.) The following sensor on Adafruit is an IMU but they call it a 9DOF sensor. Why 9 and what is DOF? https://www.adafruit.com/product/2472
    e.) This sensor here though is a 10DOF sensor. Why 10? What extra sensor does this one have that the 9DOF does not? https://www.adafruit.com/product/1604 (Note this sensor is discontinued)
    f.) What is the communication protocol between this breakout board and your microcontroller.

5.) Assume you have a solar panel that outputs 200W at 12V.
    a.) First determine the maximum current that would come out of the solar panel.
    b.) Create a voltage divider circuit with a total impedance of 4 kOhms that reduces 12V to 5V. Determine resistors R1 and R2.
    c.) Assume you hook the 5V end of the voltage divider to a voltmeter that has a 4 MOhm input impedance. Assume the solar panel has no output impedance. Compute the current running through the voltmeter and subtract that from your current in part a. Then determine the actual output power of the solar panel assuming this loss from measuring voltage
    d.) Draw a picture of your entire circuit.

6.) Assume you have a rotorcraft that spins rotors at 6000 rpm and you'd like to filter out this frequency from your accelerometer measurements.
    a.) To that end, design a low pass butterworth first order filter with a dc gain of 1 and a dc impedance of 2000 Ohms.
    b.) Assume the cutoff frequency is 6000 rpm and compute the capacitance required for this butterworth filter.
    c.) Find a capacitor on Digikey with the same amount of Farads and include a photo and link to that capacitor.
    d.) Draw a picture of your filter

Resistance Data (Ohms) from -100C to 400C in intervals of 10C

59.57
63.68
67.78
71.85
75.91
79.96
83.99
88.01
92.02
96.01
100.00
103.97
107.93
111.87
115.81
119.73
123.64
127.54
131.42
135.30
139.16
143.01
146.85
150.68
154.49
158.29
162.08
165.86
169.63
173.39
177.13
180.86
184.58
188.29
191.99
195.67
199.35
203.01
206.66
210.30
213.92
217.54

221.14
224.74
228.32
231.89
235.44
238.99
242.52
246.05
249.56