ENGR 121 – Fishtank Control System Evaluation

Student Names: ____

1. Fill in the tables below prior to the day of testing (10%):

salinity calibration eqn (salinity in terms of analog input)	
salinity calibration eqn (analog input in terms of salinity)	
deadtime compensation (seconds)	
3 x standard deviation of random error (analog value)	
gain used to correct salinity when control limits exceeded	

quantity	**salinity (%wt NaCl)**	**analog input**
UCL		
setpoint	0.10	
LCL		

temperature calibration eqn (T in terms of analog input)	
temperature calibration eqn (analog input in terms of T)	
3 x standard deviation of random error (analog value)	

quantity	**temp (°C)**	**analog input**
UCL		
setpoint	25	
LCL		

Students: Prepare System for Testing:

1. Rinse your system with DI water.
2. Fill your fishtank with 0.1% weight NaCl water. This is the setpoint to use in your sketch. .
3. Fill your fresh water reservoir with DI water (about ½ full should be enough).
4. Fill your salty water reservoir with 1% weight NaCl water (about ¼ full should be enough).
5. Set your program to a target temperature of 25°C (your instructor will ask you to set this a couple of degrees above the ambient temperature to reduce your heating cycle time).
6. Turn your system on and allow the temperature to reach the set point. The salinity should also be stable (no valves going on and off).
7. Raise your hand when you are ready for your system to be inspected and tested.

2. Instructor Inspection of System and LCD (10%):

Your LCD should be formatted as shown below. The information on the first three lines of the LCD should never change (unless your instructor changes the setpoints). The last line should display the current salinity, the current temperature, and the status of the heater (on or off).

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0					L	C	L					S	P				U	C	L	
1	S	:		0	.	0	7	2		0	.	1	0	0		0	.	1	0	8
2	T	:			2	4	.	2			2	5	.	0			2	5	.	9
3	S	=	0	.	1	4	8		T	=	2	3	.	7		H	=	o	n	

Item	(Y or N)	Comment
LCD is configured as shown above (5%)		
LCD responds in a prompt and steady fashion. That is, the display doesn’t flicker, salinity & temp values change correctly, heater status changes cleanly to on or off. (5%)		

3. Instructor Testing of System (60%):

a. Squirt some DI water into your tank, decreasing salinity and temperature below UCL values.
b. Observe system behavior.

Item	(Y or N)	Comment
Temperature on the LCD decreases (5%)		
Heater comes on when temp is below LCL and program control is transferred back to the measurement loop as the water heats (10%)		
Heater goes off when temp exceeds UCL (5%)		
Salinity value on LCD decreases (5%)		
Salty valve opens to deliver water (5%)		
Program control transfers back to the measurement loop as the deadtime passes (5%)?		
Conductivity reading on screen increases (5%)?		
Valve remains closed when salinity is between LCL and UCL? (5%)		

c. Squirt salty water into the tank, increasing the salinity above the salinity UCL (and possibly the temperature below the temperature LCL). Observe system behavior.

System can effectively control salinity between LCL and UCL AND temperature between LCL and UCL. (10%)		
Show your instructor your serial monitor, indicating when you are entering and leaving various functions so that program flow can be monitored. Also, print all variables and calculated values, and identify variables as they are printed. (5%)		

Observations. If part of your system is not working correctly, please use the space below to describe the problem and how you think the problem can be solved.

4. **(5%)** Attach a spreadsheet that includes the 20 data points collected when determining the random error in salinity. Show the standard deviation σ as well as the value of 3σ (the distance between the setpoint and the control limits.

5. **(1%)** Attach a spreadsheet that includes the 20 data points collected when determining the random error in temperature. Show the standard deviation σ as well as the value of 3σ (the distance between the setpoint and the control limits.

6. **(2%)** Attach a spreadsheet and a plot containing the data used to determine the deadtime compensation. Be sure to include the numerical value of the deadtime resulting from this analysis.

7. **(5%)** Attach the data that you used to calibrate your salinity sensor as well a plot showing the trendline and equation (analog input vs. salinity). Also invert this equation showing how salinity is computed based on analog input.

8. **(2%)** Attach the data that you used to calibrate your temperature sensor as well a plot showing the trendline and equation (analog input vs. temperature). Also invert this equation showing how temperature is computed from the analog input.

9. **Quality of Sketch (5%):** Attach a listing of your sketch. You may change your sketch if needed when you are preparing your system for testing during class to improve system function. However, you will be graded based on the sketch submitted.