# LAB 1 WORKSHEET

**Warm-Up**

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| **1. Write down the equation (symbolically) for the 40th output for a 3rd order (4-point) moving average filter. Use the equation in section 2.5.** |
| **2. Determine the smallest voltage that can be resolved by this ADC? The full-scale voltage range is 20V (bipolar ±10V).** |

**Part A**

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| **3. Look at the signals in the scopes and write down your observations with respect to the impulse response of all the filters. Do the filters behave as expected?** |
| **4. Compute the time delay for the two moving average filters. Use the “Scope all” graphs to verify your results. Are the results the same? What is the delay of the 2nd order Butterworth filter?** |
| **5. Look at the signals in the scopes and write down your observations with respect to the impulse response of all the filters. Do the filters behave as expected?** |
| **6. Set the frequency of the sine wave equal to 4\*pi (2Hz) and observe the new result. Repeat for a frequency of 8\*pi (4Hz). What is happening to the signal? What does this tell us about the limits of the MA filter?** |

**Part B-1**

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| **7. What do you see?**  **Also, how does the accuracy of the tachometer compare encoder speed values?** |
| **8. Assuming the sensor is operating within specifications, what factors could be contributing to the variation in the signal?** |
| **9.** **Using the Nyquist theorem in Section 2.4.4, what is the maximum frequency that our system sampling rate allows us to capture from any sampled signal**?  System Sampling Rate: \_\_\_\_\_\_\_\_\_\_ Maximum Frequency:\_\_\_\_\_\_\_\_\_\_\_ |

**Part B-2**

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| **10. Record your observations with respect to the relative performance of the filters. For this application, which of the filters has the best performance if time delay is NOT an issue? Why?** |
| **7. Print a copy of the 'Scope - All' figure. Make sure to label the individual signals on your graph. Zoom In to get a clearer picture.**  PRINT YOUR GRAPH AND ATTACH TO WORKSHEET |

**Part B-3**

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| **8. Record your observations with respect to the relative performance of the filters.** |
| **9. Print a copy of the 'Scope - All' figure. Make sure to label the individual signals on your graph. Zoom In to get a clearer picture.**  PRINT YOUR GRAPH AND ATTACH TO WORKSHEET |