**MECH 5970/6970 INTERMEDIATE SPECIAL TOPICS IN MECHANICAL ENGINEERING: APPLIED MECHATRONICS**

Project 3: Digital Control

The performance requirements are $\zeta = 0.707$ and $t_{2\%} = 0.5 \, sec$.
The pendulum has the following properties:

- $L_{rod} = 101.6 \, mm$
- $m_{rod} = 18.14 \, g$
- $m_{bob}(cylindrical, axis \, of \, symmetry \, rod \, axis) = 32 \, g$
- $r_{bob} = 6.35 \, mm \, (0.25 \, in) \, (note \, radius \, is \perp \, to \, rod)$
- $Servoamp \, gain = 0.3 \dfrac{Amp}{Volt} \left(\dfrac{current \, output}{command \, voltage \, input}\right).$
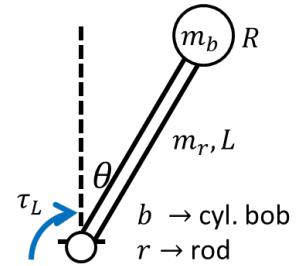
Submission Instructions: Project 3 will be submitted in two parts:
1. Demonstration of Control by 4/1 9:00 AM
2. Final Submission due 4/4 by 9:00 AM: Submit a SINGLE pdf document that includes:
   o Team member names
   o Supporting calculations, easy to read, with annotations to describe methods. For example:
      - Describe the continuous domain FSF gains.
      - Describe how you determined if amplification prior to ADC was required.
      - Describe conversion from continuous domain gains to digital.
   o Code (as text, with files provided upon request).
   o Photo(s) [max 3] of digital control circuit and connections to the pendulum.
   o Evidence of the following for TWO different sample rates (i.e., 50 and 500 Hz, not 499 and 500 Hz).
      - Position signal to verify performance requirements (ζ, t_s).
      - Verification of performance requirements at least at the higher loop rate through system identification techniques
      - Discussion of the performance at different loop rates
      - Video (make sure you have an active hyperlink to YouTube video), plots, screenshots and other evidence to support successful control of inverted pendulum.

References: datasheets are uploaded to the canvas page for relevant subsystems/components.
- Voltage Regulator: LM336 (LM336Z-5.0/NOPB-ND)
- Maxon RE-30 (P/N 310007)
- Midori CP-45 (10 KΩ) Potentiometer
- AMC B12A6 Linear Current Amplifier

Testing Dates: Testing will occur during class periods/office hours the week of 3/28. Priority will be given to those with office hours conflicts. If you require another time slot, email me.

Grading Rubric:

Criteria	Points
Supporting Calculations	15 pts
Data for two loop rates + sys ID and discussion	15 pts
Control of pendulum to spec, and calculations to support	20 pts