EEE4117F Flywheel Project –Part B

Prepared by:

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Determining the DC Machine constants

The machine is set up as shown in Figure 1 below and run at different speeds the induced back-emf at the terminals of the machine, corresponding to each of the speeds, is recorded. A graph of back-emf E_a vs. Speed ω_m is plotted. The slope of this graph gives the constant $K_a\emptyset$.

Remember: $E_a = K_a \emptyset \omega_m$

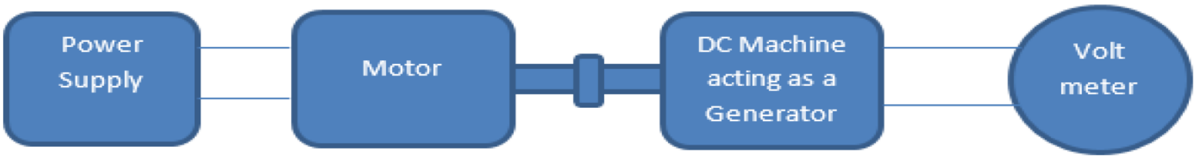


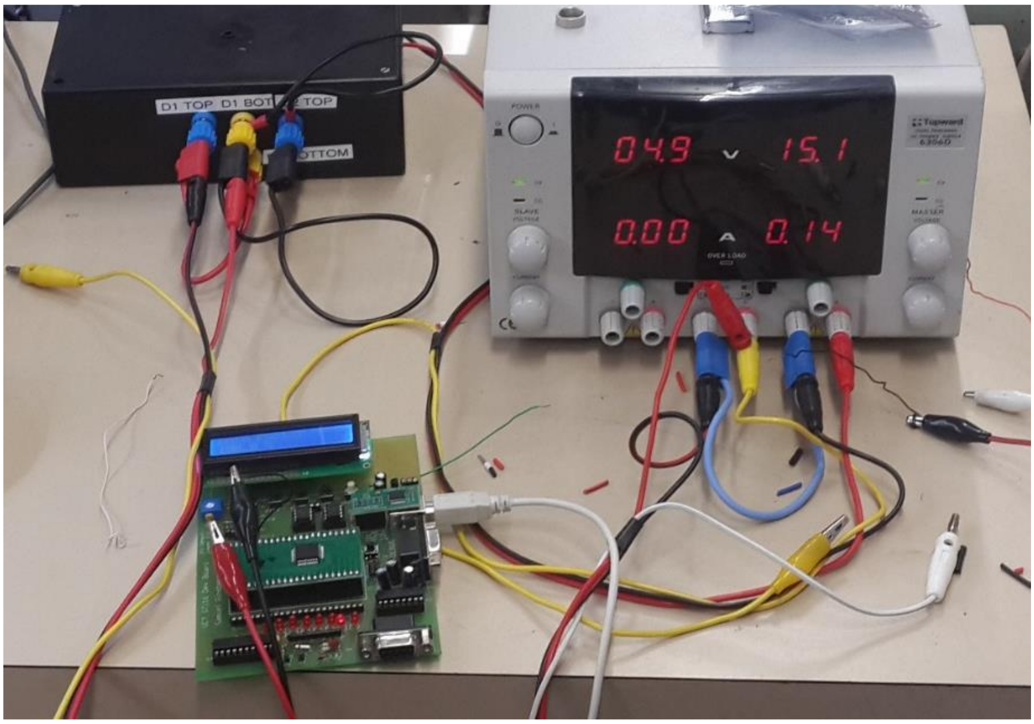
Figure 1| Set-up for the no-load test

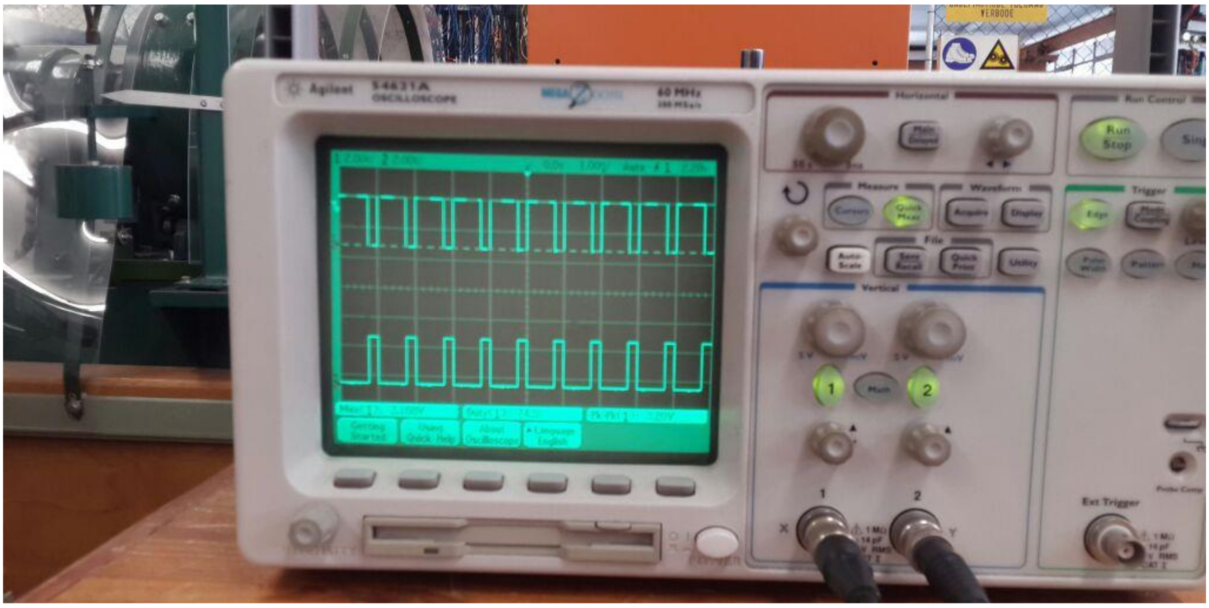
Task 1: PWM

Program a microcontroller to produce PWM for the H-bridge; 1 kHz with a duty cycle from 50% to 100%. The voltage to turn on the switches of the H-bridge is approximately 3V. Remember that in practice, it is crucial to ensure that there two switches in the same leg are never closed at the same time. The motor is controlled by an H-Bridge. The H-Bridge accepts two PWM signals, one the inverse of the other.

Question: Why is this so? And how would you solve this problem? *(Explain thoroughly)* You will also be required to append your well documented code for the PWM.

Test the output of the microcontroller on an LED in the lab. You will also need to append screenshots of the readings of your PWM from the oscilloscope to your project.





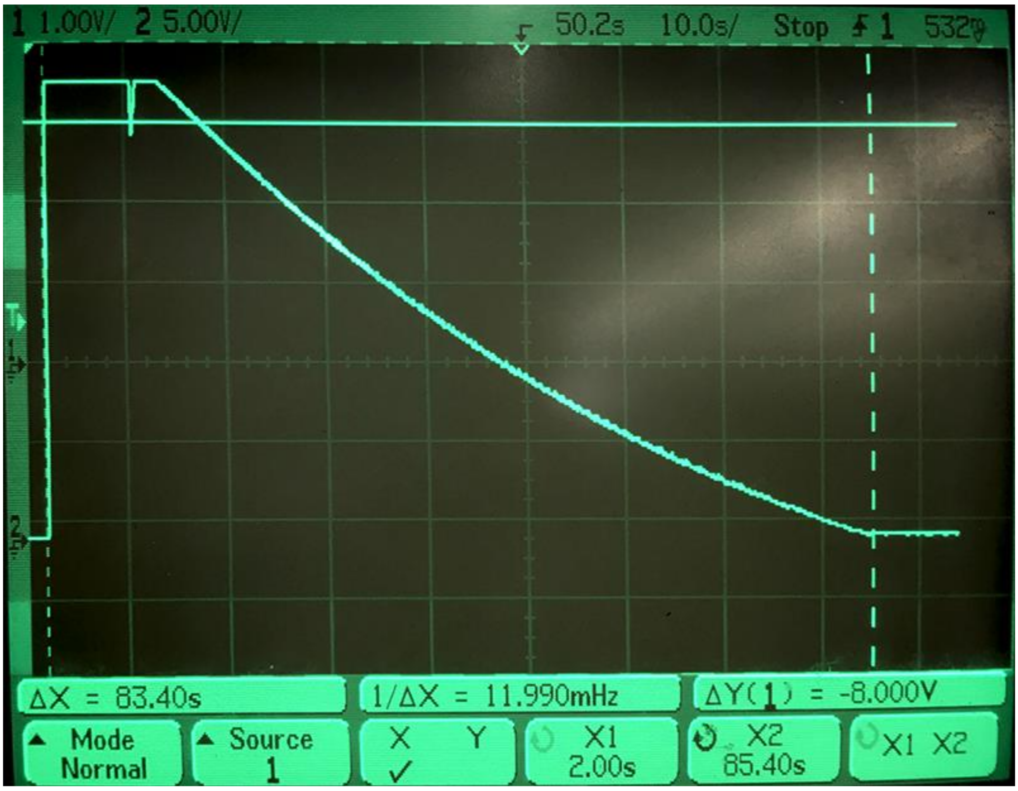
Task 2:

Connect your microcontroller to the drive system.

Run the flywheel to rated speed 300 rpm by slowly increasing your duty cycle. Record the bridge current, bridge voltage, armature current, and the speed in the table provided.

RPM	Bridge Current	Bridge Voltage	Armature Current	Armature Voltage	Torque
50	0.2	45	0.9	8	0.16
100	0.4	43	1.0	12	0.23
150	0.5	42	1.0	18	0.26
200	0.7	41	1.1	25	0.27
250	0.9	41	1.1	30	0.32
300	1.1	40	1.1	37	0.35

Now perform a run-down test. Let the flywheel run down as the power dissipates over the set resistors. Record the time it takes to decelerate to 0 rpm.



Questions:

1. Plot the graph of Armature Voltage vs. Speed
2. Determine from the graph plotted; $K_a\phi$ and armature resistance Ra.
3. Determine the losses due to the armature winding.
4. Plot the graph of Mechanical losses vs. Speed.
5. Calculate the average bridge losses.

Task 3:

Discuss two application areas of flywheel energy storage system (minimum one A4 page). State features, two advantages and one major drawback of each system.