ME 576 HW #8 2021 Due: 4/29/2021

1. A DC motor (wound, brush types) consumes a 2 HP under no-load condition to maintain a constant speed of 600 rpm. The motor torque constant K_T = 1 kg•m/A, the rotor-shaft moment of inertia J_m = 0.1Kg-m^2, the voltage constant K_b = 1 V•s and the armature circuit resistance R_a = 10Ω.

   (a) Calculate the maximum torque and acceleration attainable from this motor-shaft system.

   (b) Determine the total damping coefficient of this motor-shaft system.

   (c) Determine the maximum speed and power available from this motor by using the speed control when the maximum voltage must be limited to 250V.

2. A brush type DC motor is used to drive an NC table. The torque constant K_T=2 kg·m/A and the voltage constant K_b=1 V·s. The electric resistance of the rotor circuit is 4 ohms and the total equivalent moment of inertia of the shaft-table is 6 kg-m^2. Ignore the effect of inductance in the armature circuit.

   (a) Determine the maximum torque available from this motor with the rotor input voltage of 100V.
   (b) The motor is required to deliver a constant torque up to 2,000 rpm by armature control. If the armature current is maintained at a constant level calculated in (a), determine the rotor voltage increase needed to increase the speed from 0 to 2,000 rpm.
   (c) Calculate the maximum acceleration achievable by this motor-table unit under no external load.
   (d) What percentage of stator current increase or reduction is needed to further increase the speed of the motor to 3000 rpm by field control? Determine the <u>torque</u> at this speed.

3. A three phase induction motor has one pole pair per phase. The equivalent resistance and leakage inductance in the rotor winding are 10 Ω and 0.06 H, respectively. The motor is supplied with 220 V in each phase at 60Hz. Compute the torque-speed relationship and generate a plot.