EE4001 Quiz 1: DC Machines

Student Name: **Student Number:**

1. Sketch a plot of torque vs. angle for a primitive two-pole dc motor with an armature winding consisting of 4 coils wave wound.

2. Derive the torque-speed characteristic equation for a dc machine.

3. A generator develops a back emf of 100 V at 1000 rpm. Under full-load current draw of 10 A, the field flux is weakened by 5 % due to armature reaction. Calculate the full-load terminal voltage when the armature resistance is $0.5\ \Omega$.

4. A 250 V, 400A compound generator has 1000 shunt-field turns per pole and 3 series-field turns per pole. What is the effective field current when the series-field current is 5 A?

5. Sketch together the induced emf and phase current in regenerative mode for a single phase of a three-phase trapezoidal-waveform electronically-commutated motor.

6. An EC dc motor is sourced by a 50 V supply, and pulls 10 A from the source. The phase-phase resistance is $0.5\,\Omega$. The output speed is 5000 rpm. What are the output torque and machine efficiency, neglecting core, friction, and windage losses?

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PROBLEM 1: A **permanent-magnet** dc motor is known to have an armature resistance of 1.03 Ω. When operated at no load from a dc source of 50 V, it is observed to operate at a speed of 2100 rpm and to draw 1.25 A. Find (a) the motor constant, (b) the no-load rotational losses of the motor, and (c) the power output in horsepower of the motor when it is operating at 1700 rpm from a 48 V source.

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PROBLEM 2: A wound-field dc motor is driving a load whose torque requirement increases linearly with speed (squared-power load) and reaches 5 Nm at a speed of 1400 rpm. The armature terminal voltage is held to its rated value. At the rated flux the no-load speed is 1500 rpm and the full-load speed is 1400 rpm. If the flux is reduced to 80 % of the rated value, calculate the new steady-state speed.