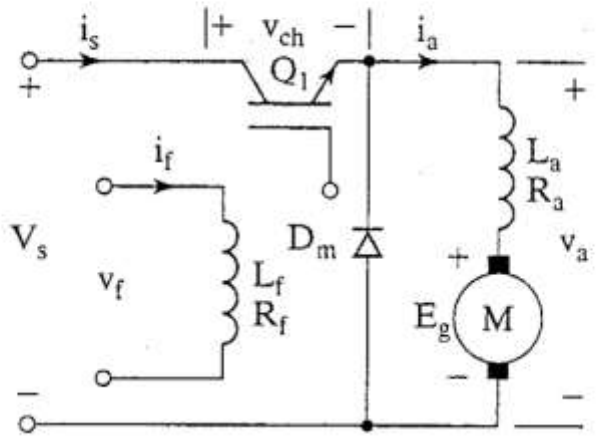
Problem Sheet 3

Submission date: 31-03-2024

1.

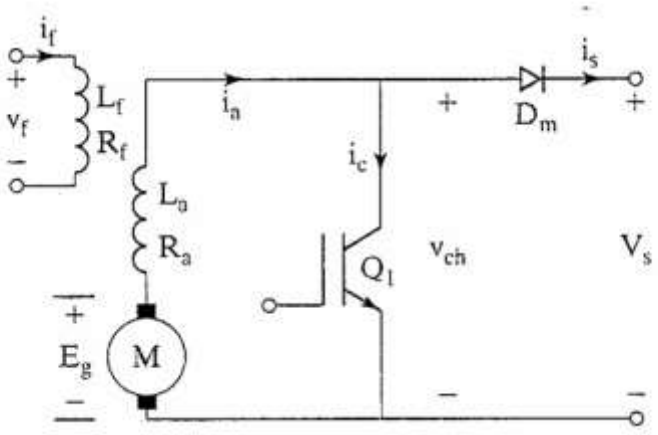
A dc separately excited motor is powered by a dc-dc converter, as shown, from a 600V dc source. The armature resistance is $R_a = 0.05\Omega$. The back emf constant is $K_v = 1.527V/A$ rad/s. The average armature current is $I_a = 250A$. The field current is $I_f = 2.5A$. The armature current is continuous and has negligible ripple. If the duty cycle of the dc-dc converter is 60%, determine



Find a) Input power from the source, b) the equivalent input resistance of the dc-dc converter drive, c) motor speed and d) the developed torque.

2.

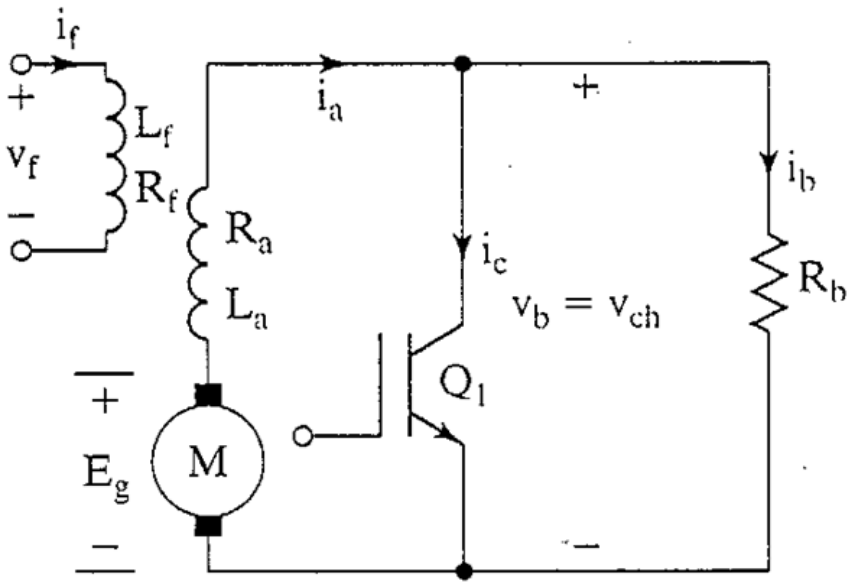
A dc-dc converter is used in regenerative braking of a dc series motor similar to the arrangement shown below. The dc supply voltage is 600V. The armature resistance is $R_a = 0.02\Omega$ and the field resistance is $R_f = 0.03\Omega$. The back emf constant is $K_v = 15.27mV/A$ rad/s. The average armature current is maintained constant at $I_a = 250A$. The armature current is continuous and has negligible ripple. If the duty cycle of the dc-dc converter is 60%, determine the following



Determine a) the average voltage across the converter, b) the power regenerated to the dc supply, c) the equivalent resistance of the motor acting as a generator, and d) the motor speed

3.

A dc-dc converter is used in rheostatic braking of a dc separately excited motor as shown below. The armature resistance is $R_a = 0.05\Omega$. The braking resistor is $R_b = 5\Omega$. The back emf constant is $K_v = 1.527V/A$ rad/s. The average armature current is maintained constant at $I_a = 150A$. The armature current is continuous and has negligible ripple. The field current is $I_f = 1.5A$. If the duty cycle of the dc-dc converter is 40%, determine:



a) the average voltage across the dc-dc converter, b) the power dissipated in the braking resistor, c) the equivalent resistance of the motor acting as a generator and d) the motor speed

4.

A dc motor is driven from a chopper with a source voltage of 24V dc and at a frequency of 1 kHz. Determine the variation in duty cycle required to have a speed variation of 0 to 1 p.u. delivering a constant 2 p.u. load. The motor details are as follows:

1 hp, 10 V, 2500 rpm, 78.5 % efficiency, $R_a = 0.01\ \Omega$, $L_a = 0.002$ H, $K_b = 0.03819$ V/rad/sec

The chopper is one-quadrant, and the on-state drop voltage across the device is assumed to be 1 V regardless of the current variation.