AUBURN UNIVERSITY

Electric Vehicles

Homework – DC Motor Drives

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https://en.wikipedia.org/wiki/DC_motor

Problem 1 - A permanent-magnet dc motor with the following parameters:

$K\phi := 0.5 \cdot Wb$ (in a permanent magnet motor, the flux cannot be changed)

The armature resistance is $R_A := 0.25\ ohm$; The rated torque $T_{rated} := 12\ N \cdot m$;
The rated speed: $\omega_m := 3700 \cdot rpm$

a) Calculate the terminal voltage V_A, if the motor is required to deliver a torque of $T_{load\_1} := 5 \cdot N \cdot m$ at a speed of $\omega_m := 1500 \cdot rpm$ (Answer: V_A = 81.04 V)
b) Compute the winding (copper) losses in the armature winding problem (a)
c) Compute the input power and the efficiency of the motor for problem (a)

Problem 2 - A separately-excited dc motor with the following parameters:

The armature resistance is $R_A := 0.45\ \Omega$; The rated torque $T_{rated} := 11\ N \cdot m$;
The rated speed: $\omega_{m\_rated} := 2000 \cdot rpm$; Rated armature current $I_{A\_rated} := 20\ A$

a) At rated flux calcute the $K\phi$ of this motor to get rated torque at rated armature current (Answer $K\phi$ = 0.55 Wb)

b) At rated power and rated speed, the efficiency is computed to be $Eff := 90\%$ calculate the field winding loss (Answer P_{field_wdg} = 75.982 W)

c) The motor is operated 120% rated speed, thus, the motor must be operated in flux weakening region (constant power region) because the voltage V_A has reached its maximum limit. Calulate the reduced flux for this operation (Answer $K\phi$ = 0.458 Wb)

d) Calculate the maximum torque you can get for problem (c) without overloading the motor?

DC-Motor Drive Capabilities

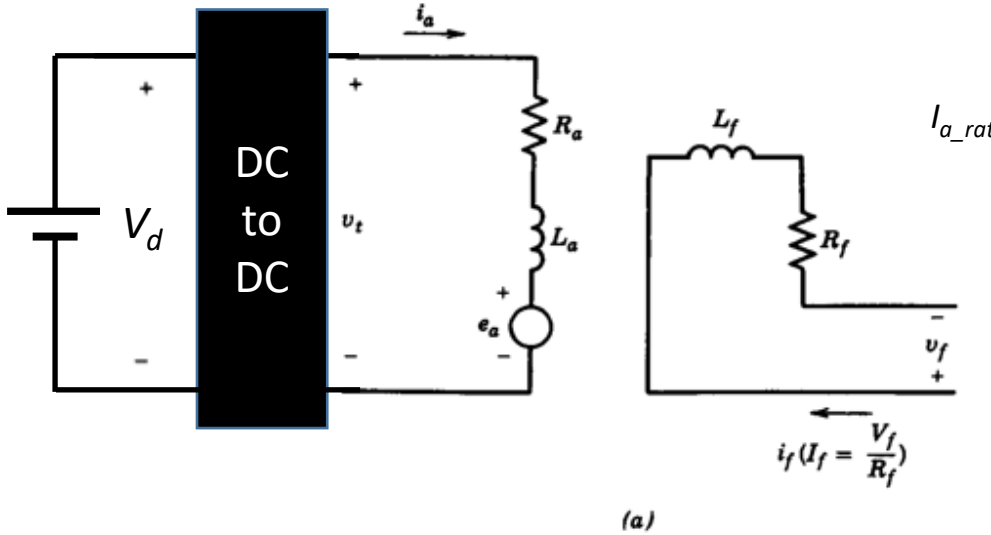
Problem 3

Describe the operation of the Separately excited DC Motor drives shown in this page.

Example V_{t1}, $I_{a1} > 1.0pu$, $T_{em1} > 1.0pu$, $P_{input1} < 1.0pu$, Overload

Questions:

V_{t2}
V_{t3}
V_{t4}
V_{t5}
V_{t6}
V_{t7}



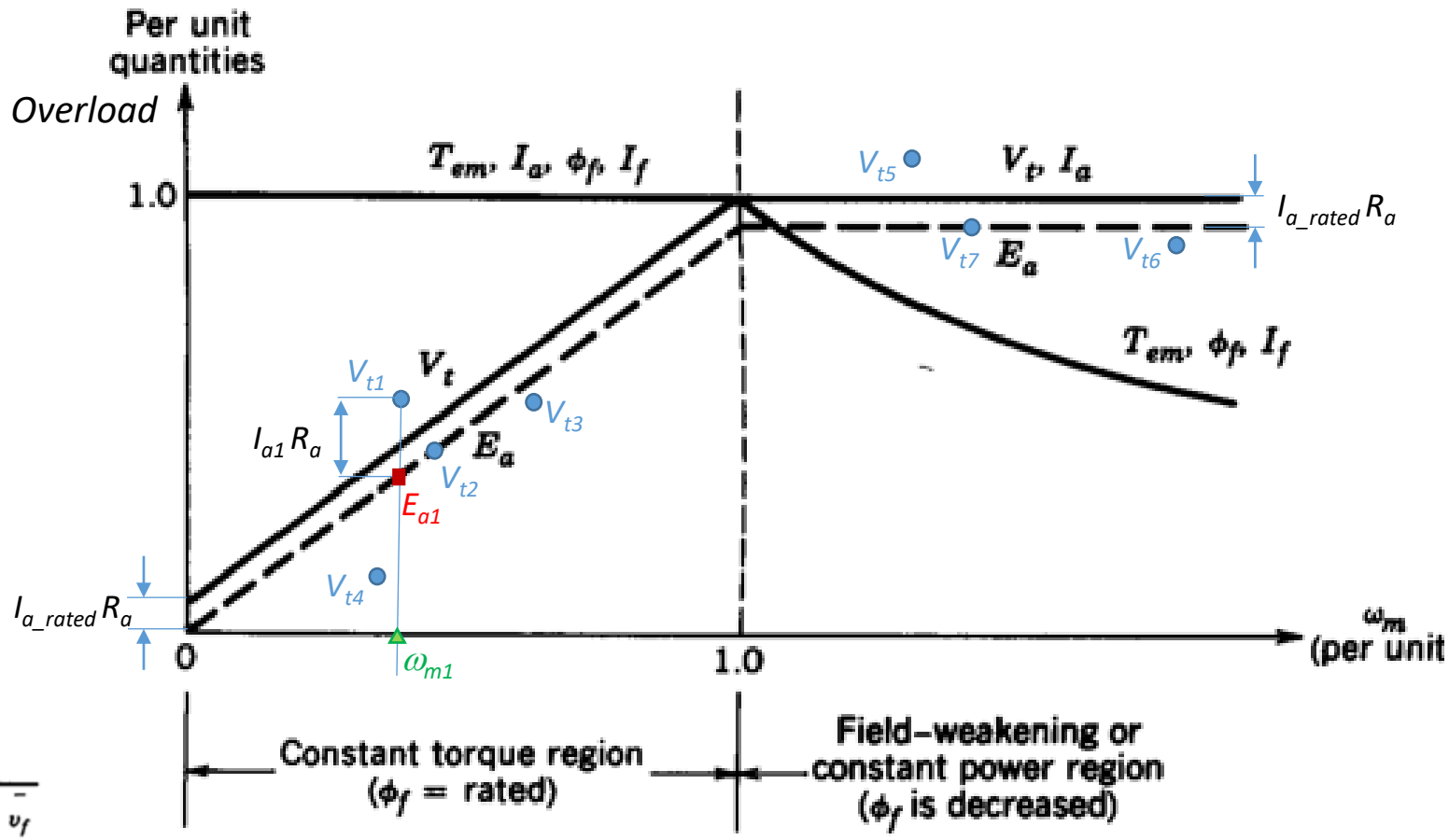


Figure 13-5 Separately excited dc motor: (*a*) equivalent circuit; (*b*) continuous torque–speed capability.