

Problem 1: Characteristics of an interior-permanent-magnet motor

The data of an interior-permanent-magnet synchronous motor is:

rated voltage	$U_N = 400 \text{ V}$	direct-axis inductance	$L_d = 0.06 \text{ H}$
rated current	$I_N = 10 \text{ A}$	quadrature-axis inductance	$L_q = 0.10 \text{ H}$
pole pairs	$p = 2$	permanent-magnet flux	$\psi_F = 1 \text{ Vs}$

The stator resistance is omitted. Draw the following characteristics in the i_d - i_q plane:

- (a) constant current $i_s = \sqrt{2}I_N$ (rated value);
- (b) constant torque of 30 Nm;
- (c) constant stator flux $\psi_s = 1 \text{ Vs}$.

Problem 2: Current-minimizing control characteristics

Consider the interior-permanent-magnet motor in the preceding problem.

- (a) Derive expressions for the current components i_d and i_q , when the stator current is constant and the torque is maximized.
- (b) Calculate the maximum torque at the rated current.
- (c) Calculate the rotational base speed corresponding to the rated voltage for the current and torque obtained above.
- (d) Calculate the displacement power factor $\cos \varphi$ and draw a vector diagram for the operating point obtained above.