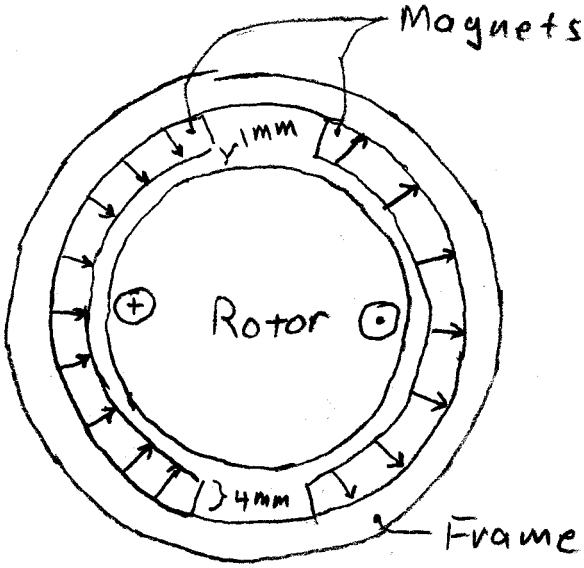
ELEC 435
Problem Set 7
Due: October 24, 2014

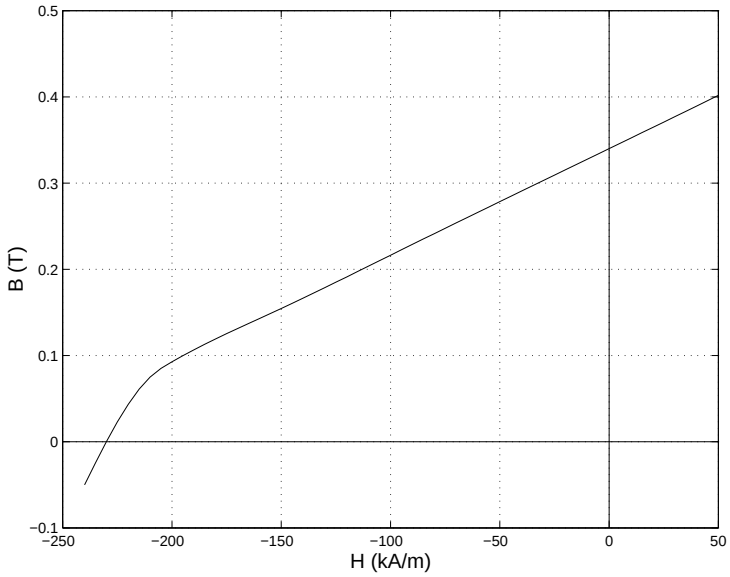
Homework Problems.

H7.1 A permanent magnet DC motor has an air gap flux that may be assumed to be constant under all operating conditions. With no load torque, the motor operates at a speed of 6000 rpm when its armature is connected to a 120 V supply. The armature resistance is 1.5 Ω. Rotational losses may be ignored. Determine the motor speed when connected to a 60 V supply and providing a torque of 0.5 Nm.

H7.2 A permanant magnet DC commutator motor produces a torque of 8 Nm with an armature current of 10 A. The armature resistance is 0.16 Ω. If the motor is to drive a mechanical load requiring a torque of 20 Nm at a speed of 1800 rpm, what voltage must be applied to the armature terminals?

H7.3 The figure on the left is a cross-sectional view of a permanent magnet DC motor. The magnets are made of a ferrite material whose characteristics are given in the graph on the right, and are fully magnetized in the direction shown. The magnets are 4 mm thick and the air gap is 1 mm. The rotor is 30 mm in diameter and is 40 mm long. The armature winding consists of a single coil having 200 turns. If a current of 250 mA is flowing in the armature how much torque will be produced? Make and state any necessary assumptions.





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Quiz Problems.

Q7.1 The structure below is 300 mm thick (dimension d). The width of the air gap (w_g) is 650 mm, and its length (l_g) is 60 mm. The shaded region is a permanent magnet made of Nd-Fe-B, and the remainder of the structure is made of a material having negligible reluctance. The demagnetization curve for Nd-Fe-B is shown on the right. Because the knee is below the H-axis, we can assume that the recoil line lies on the B-H curve.

It is desired to maintain a magnetic flux density of 0.4 T in the air gap. What are the dimensions of the magnet (l_m and w_m) which provides the required field in the gap while using the minimum amount of permanent magnet material? (Neglect fringing and leakage flux.)