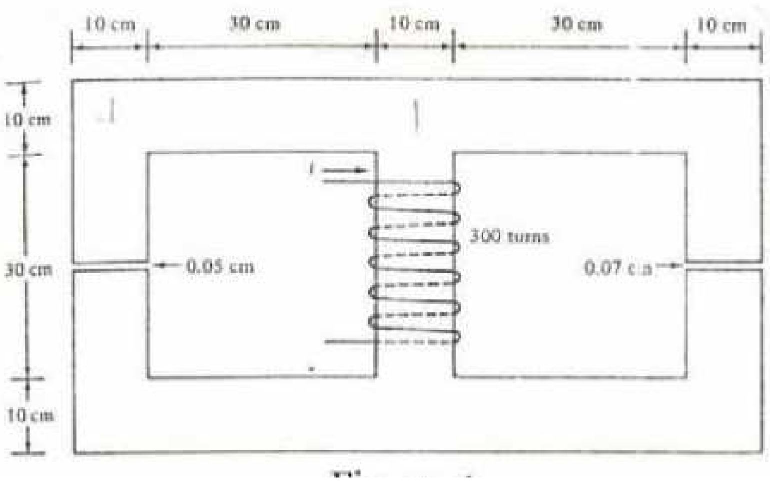
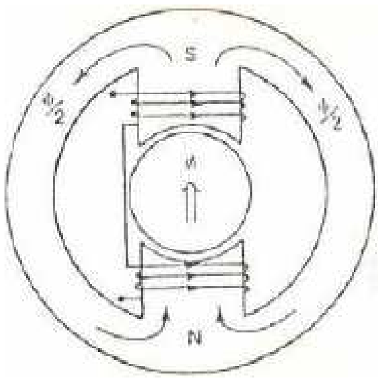
King Fahd University of Petroleum & Minerals
Electrical Engineering Department

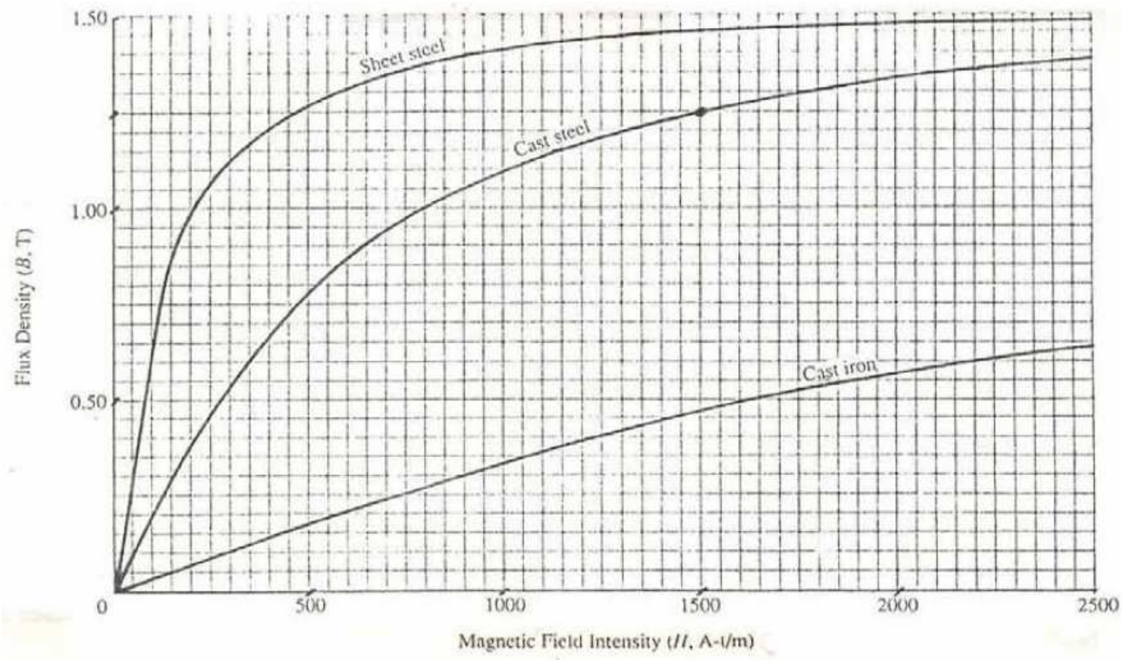
EE-360 Problem session #1, 2014, 132

Problem 1:
A ferromagnetic core with a relative permeability of 2000 is shown in figure below. The dimensions are shown in the diagram and the depth of the core is 7 cm. The air gaps on the left and the right side of the core are 0.05 cm and 0.07 cm, respectively. Because of the fringing effects, the effective area of the air gaps is 5% larger than their physical size. If there are 300 turns in the coil wrapped around the centre leg of the core and if the current in the coil is 1 A:
What is the flux in each of the left, centre and right legs of the core?
What is the flux density in each air-gap?



Problem 2:
The shunt-field winding of a DC 2-pole machine has 1200 turns as shown in figure below. The magnetic flux path has a net cross-sectional area of 200 cm^2. The iron portion has a mean length of left and right legs of 20 cm and the centre portion of 10 cm. There are two air-gaps each 0.1 cm in length. The magnetization curve below for cast steel may be taken to apply throughout the iron circuit. Determine the shunt field current required to produce a flux of 0.02 Wb in the air gaps





Problem 3:
A 150-kVA, 2400 / 240-V, 60-Hz, transformer has the following equivalent circuit parameters:

R_c= 10000 Ω	X_m= 1550 Ω
R_1= 0.2 Ω	R_2= 0.002 Ω
X_1= 0.45 Ω	X_2= 0.0045 Ω

The transformer delivers the rated load at 240 V and 0.8 power factor lagging. Use the exact equivalent circuit to calculate the primary voltage, voltage regulation, and the transformer efficiency

Problem 4:
A 10-kVA, 450 / 120-V, 60-Hz, transformer gives the following test results:

Open circuit test (HV side open):	120V,	4.2A,	80W
Short circuit test (LV side short):	9.65V,	22.2A,	120W

(a) Derive the approximate equivalent circuit referred to the high-voltage side.
(b) Determine the voltage regulation at full load and 0.8 PF leading.
(c) Determine the efficiency at 50% of full load and 0.8 PF lagging.