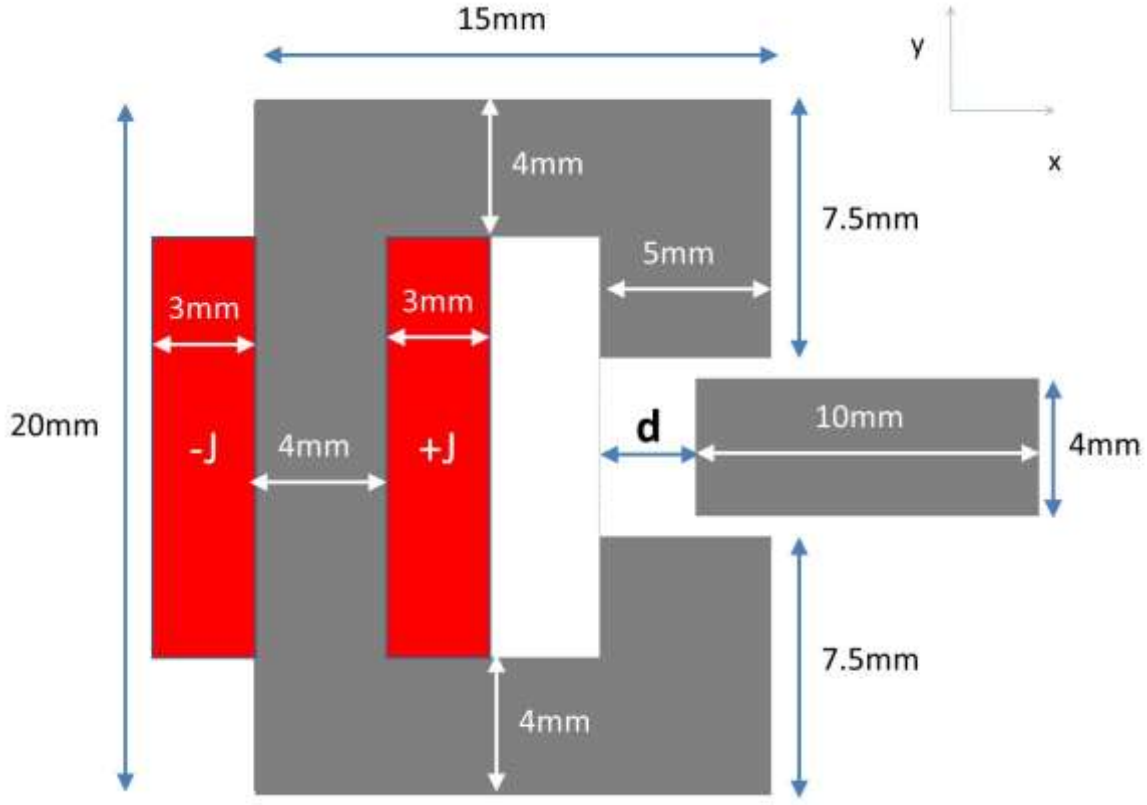
EEE349 Power Engineering Electromagnetics

Finite Element Analysis – Problem Sheet 3

The diagram below shows a cross-section through an inductive position sensor in which displacement of a moving plunger is inferred from a change in coil inductance. The sensor has a depth in the z-direction of 20mm (not shown in diagram), but can be regarded for the purposes of this exercise as being suitable for 2D planar analysis (it should be recognised that this is an approximation).

The coil operates at a peak current density of 0.2 MA/m^2. The coil has 100 series turns.

The stator core and plunger are both manufactured from Supermalloy which is Nickel Iron that is often used in inductive sensors (listed in the FEMM materials database)



a) Use a simplified magnetic circuit analysis to estimate the value of inductance for x=0mm to provide some guidance for your subsequent FE analysis.

b) By modelling half the sensor using the appropriate boundary conditions and, calculating the inductance of the coil in increments of 1mm, establish the variation in inductance over the range d = 0 to 5mm, and hence determine the degree to which the device exhibits a line variation in inductance with displacement.

[Hint the integral of the vector potential over a region is equal to the flux which links that region]

12/12/13