**Q1) Analytical modelling of the inductor**

1. Calculation of reluctance for initial permeability:

First assume that there is no DC bias in the core and permeability is constant. Initial permeability of the core is 40. Reluctance can be calculated as,

: Mean length of the core = 243 mm

: Cross section of the core = 358 mm2

1. For 250µH inductance the required number of turns is calculated as below. In the calculation constant permeability is assumed as in part-a. Also, all flux is assumed to travel in the core and there is no fringing flux.
2. For improved inductance calculation, fringing flux should also be included. Fringing flux introduces additional parallel flux path. Then effective reluctance decreases which increases the inductance. Moreover, in the above calculations, homogeneous flux distribution is assumed in the core which is non-realistic. Flux tries to flow in the shortest path so flux distribution is larger in the inner path. FEA modelling improves the inductance calculation.