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EE214000 Electromagnetics, Fall 2020

Your name: _____ ID: _____ Dec. 21st, 2020

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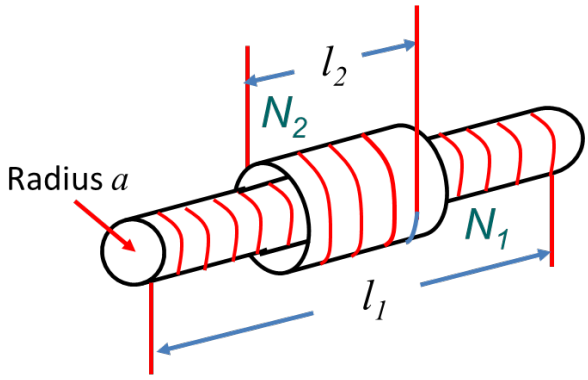
Quiz #15-1, Open books, notes (18 points), due 11 pm, Wednesday, Dec. 23rd, 2020
(submission through iLMS)

Late submission won't be accepted!

1. What is the reluctance of a piece of magnetic material of permeability μ, length l, and a constant cross section area S? Explain why the dependence of a reluctance is proportional to l and yet inversely proportional to μ and S. Don't just write a formula to show the dependences. Explain it from physical points of view. (5 points)

2. A thin ($r_0 >> a$ n Example 6-10) toroid is filled with a ferromagnetic core ($\mu_r >> 1$) and excited with mmf NI. There's a small air gap cut into the ferromagnetic core. How could the B in the air gap (having $\mu_r = 1$) be the same as the B in the ferromagnetic material (having $\mu_r >> 1$)? If the air gap is not "small", but is about, for instance, 1/3 of the toroid, would B remain the same over the whole axis of the toroid? (5 points)

3. The textbook asserts that the mutual inductance $L_{12} = L_{21}$, but the following case gives you an answer of $L_{12} = \frac{\Lambda_{12}}{I_1} = \pi a^2 \frac{\mu_0 N_1 N_2}{l_1}$, which does not lead to $L_{12} = L_{21}$ when you swap the indices 1 and 2 in the expression. What has gone wrong with the calculation or the formula? (5 points)



4. You fly over the north pole of the earth and drop a coin with its surface normal along the polar axis. Which direction, clockwise or counterclockwise, would the earth magnet induce a current on it when you look down the coin? (3 points)