Quiz 2

ECE 476

Name:_____

1. A 60-Hz single –phase, two-wire overhead line has solid cylindrical copper conductors with 2.4 cm diameter. The conductors are arranged in a horizontal configuration with 3 m spacing. Calculate the inductance of each conductor due to both internal and external flux linkages in mH/km (40 points).

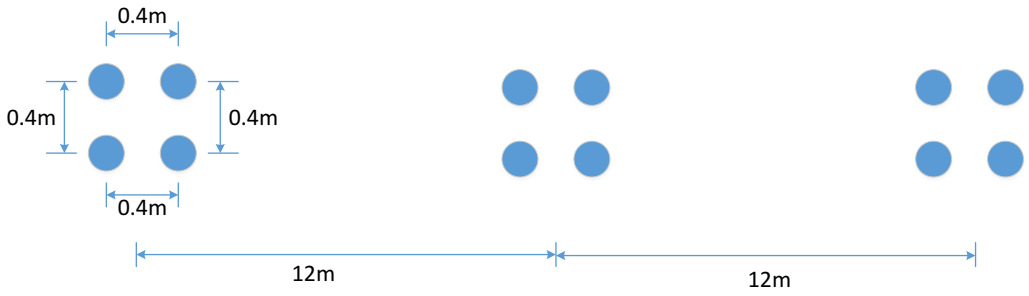
$$L_x = L_y = 2 \times 10^{-7} Ln\left(\frac{D}{r'}\right) H/m$$

$$D = 3m$$

$$r' = 0.7788 \times r = 0.7788 \times \left(\frac{0.024}{2}\right) = 9.346 \times 10^{-3}$$

$$L_x = L_y = 2 \times 10^{-7} Ln\left(\frac{3}{9.346 \times 10^{-3}}\right) \frac{H}{m} \left(\frac{1000m}{km}\right) \left(\frac{1000mH}{H}\right) = 1.154\ mH/km$$

2. The figure below is a completely transposed three-phase overhead transmission line with bundled phase conductors. All conductors have a radius of 2 cm.



a. Determine the inductance per phase in mH/km (40 points).

$$r' = 0.7788 * 0.02 = 0.0156$$

$$R_b = \sqrt[4]{(r')(0.4)(0.4)\left(\sqrt{2} \times 0.4\right)} = 0.1938m$$

$$D_{eq} = \sqrt[3]{D_{AB} D_{BC} D_{CA}} = \sqrt[3]{(12)(12)(24)} = 15.12m$$

$$L = 0.2Ln\left(\frac{D_{eq}}{R_b}\right) = 0.2Ln\left(\frac{15.12}{0.1938}\right) = 0.8714\ mH/km$$

b. Find the inductive line reactance per phase in Ω/km at 60 Hz (20 points).

$$X = \omega L = 2\pi 60 \times 0.8714 \times 10^{-3} = 0.3285\ \Omega/km$$