EE 483/583 Antennas for Wireless Communications
Quiz #5 (Spring 2024)

Name Key A

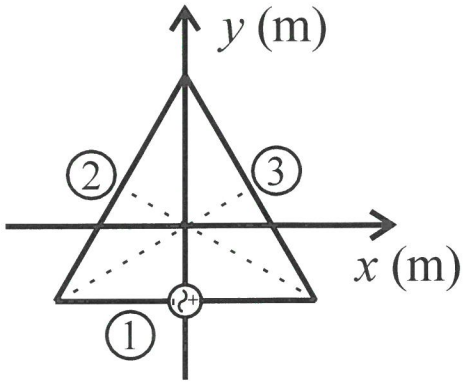
Instructions: Open book & notes. Place answers in indicated spaces and show all work for credit.

A loop antenna, 'triangantenna', is shaped in the form of an equilateral triangle on the *x*-*y* plane of 1 m side length centered so that lines from the apex to the middle of the opposing side cross at the origin (see dashed lines). The antenna is fashioned from 0 AWG (8.25246 mm diameter) aluminum wire with a conductivity of 3.5×10^7 S/m. The 100 MHz, $12\angle 0°$ V voltage source is centered on the base as shown.

$\lambda = c/f = \frac{2.998\times10^8}{100\times10^6} = 2.998\,m$

$a = d/2 = \frac{8.25246\,mm}{2}$

$= 4.12623\,mm$



a) Find wire radius *a* (mm). Can the wire be considered as 'thin'? (Yes) / No (circle correct answer)

$\frac{c}{\lambda} = \frac{2\pi a}{\lambda} = \pi d/\lambda = \frac{\pi(8.25246\times10^{-3})}{2.998} = 0.008648 << 1$

$a =$ 4.12623 mm Quantitative justification for answer $2\pi a/\lambda = 0.00865 << 1$

b) Find the shortest & longest allowable segment lengths (cm) and corresponding # of segments per side. [Constraints- No extended kernel, centered source, and segment # per side must be equal & an integer.]

From notes – $\frac{\lambda}{1000} < \Delta < \lambda/10 \Rightarrow 0.002998 < \Delta < 0.2998\,m$

Constraint $\Delta/a \geq 8 \Rightarrow \Delta \geq 8(4.12623\times10^{-3}) = 0.0330124\,m$

Now, $0.033 < \Delta < 0.2998$. Integer $\frac{1m}{0.033} = 30.29 \rightarrow 30$ longer $\hookrightarrow 29$ odd

Centered source $\Rightarrow$ odd integer

$\frac{1m}{0.2998} = 3.335 \rightarrow 4$ shorter $\hookrightarrow 5$ odd

$\Delta_{min} = \frac{1m}{29} = 3.4483\,cm$

$\Delta_{max} = 1m/5 = 0.2m = 20cm$

$\Delta_{min} =$ 3.4483 cm $N_{min} =$ 29 $\Delta_{max} =$ 20 cm $N_{max} =$ 5

c) Based on b), choose the number of segments per side. Then, write the applicable NEC-2 commands to implement the source and load all the segments with the wire conductivity. Assume tag number corresponding to the figure. $N_{chosen} =$ 15

```
EX 0 1 8 00 12.0 0.0 ! Source on 8th segment (middle)
LD 5 0 0 0 3.5E7 ! Load all segments w/ conductivity
```