Pre-lab Exercise:

NOTICE: This pre-lab exercise takes 30% of the marks of the lab. Complete this pre-lab exercise before you come to the lab session. Attach it at the end of the formal lab report.

Answer the questions below using a value of the relative permittivity derived according to the position in the alphabet of the first letter of your Surname (anyone of you). Use the formula:

$$\varepsilon_r = 1 + \left[(X / 10) \times 2 \right]$$

where X is the figure denoting the position of the first letter of your name. Thus, for example, in Andrew Davies's case (X = 4) and ε_r *= 1.8; for Simon Wong (X= 23) and* ε_r *= 5.6 .*

1) Does the velocity of propagation of an electrical signal along a cable depend on the material of which the conductors are made? What effect, therefore, is brought about by imperfect conductors?

2) What will be the velocity of propagation in a co-axial cable with copper conductors and with the inter-electrode space incorporating a dielectric medium of your value of relative permittivity? (Use other constants as given in the laboratory script.)

3) What percentage is this velocity of the velocity of light? (Note, manufacturers specify cables as a 60 % cable, 75 % cable, etc. reflecting the % speed relative to the velocity of light).

4) How long will it take for a signal to propagate along a 1 km length of the cable?

5) What is the capacitance C per unit length if the inner and outer radii (a, b) are respectively 1.5 mm and 6.0 mm. $C = 2\pi\varepsilon / \ln(b / a)$

6) Use the information from 2 and 4 to calculate i) the inductance per unit length of the coaxial cable, and ii) the characteristic impedance of the cable.

7) If your cable were to be used in a fast computer network, what termination resistor should be in place at the end of the cable to avoid any reflected signals?

8) What would be the value of the reflection coefficient at the end of the cable if the termination were made with a 1 $k\Omega$ resistor? Calculate the amplitude of the reflected signal for the case of an incident square pulse 3.5V amplitude.

9) What will be the wavelength of a 150 MHz CW signal propagating in your cable?

10) What is the shortest length of the cable at this frequency which will give rise to resonance?