Homework PHY 554 #7. **Due Nov. 19, 2025**

1. (2 points): Show that the longitudinal and transverse impedances satisfy the following relations

$$Z_{//}^{*}(\omega) = Z_{//}(-\omega)$$

$$Z_{\perp}^{*}(\omega) = -Z_{\perp}(-\omega).$$

2. (4 points)

Use the following identity

$$\sum_{p=-\infty}^{\infty} \delta(x-p) = \sum_{l=-\infty}^{\infty} e^{i2\pi lx},$$

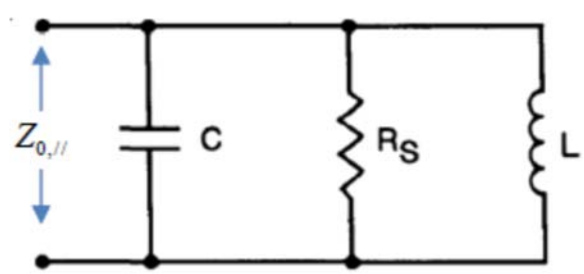
to prove Poisson summation formula:

$$\sum_{l=-\infty}^{\infty} F(lC) = \frac{1}{C}\sum_{p=-\infty}^{\infty} \tilde{F}\left(\frac{2\pi p}{C}\right),$$

where $F(z)$ and $\tilde{F}(k)$ are Fourier pairs related by

$$F(z) = \frac{1}{2\pi}\int_{-\infty}^{\infty} e^{ikz}\tilde{F}(k)\,dk.$$

3. (4 points)



Show the impedance of above circuit can be expressed as

$$Z_{0,//} = \frac{R_s}{1+iQ\left(\frac{\omega_R}{\omega}-\frac{\omega}{\omega_R}\right)},$$

and find the expression for Q and ω_R in terms of C, R_s, and L.