Physics Prelab #8: LCR Circuits/Speed of Light

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Theory:

Inductors, capacitors and resistors can be used to make filters which determine the range of frequencies which pass through a circuit. More sophisticated examples of the circuits provided here are used to select a radio signal from among all the radio waves impinging on the antenna of a radio.

Internal reflection of a light beam can occur when the index of refraction of the material containing the incident beam is higher than the index of refraction of the surrounding material. When the angle of incidence is greater than $\arcsin(n_o/n_i)$ total internal reflection occurs and the light can be guided by the optical fiber. To check that the index of refraction of the clear material in the optical fiber has a greater index of refraction than the surrounding medium you can measure the speed of light and calculate the index of refraction. The index of refraction is defined as the ratio of the speed of light in vacuum over the speed of light in the material ($n_i = c/v_i$).

Objective:

The objective of this lab is to measure the transmission voltage amplitude for a large range of frequencies using a constant input voltage amplitude; and to measure the speed of light in a fiber optic cable.

Procedure:

For the LCR Circuits lab:

First, the frequency on the signal generator was changed. Next, the seconds/division dial on the oscilloscope was adjusted so that the peak to trough voltage was easily visible. The peak to trough voltage on the input signal was then reset back to the original value using the amplitude dial on the signal generator. The volts/div for the output voltage signal was then adjusted to see the peak to trough voltage more clearly. The new output peak to trough voltage and frequency were recorded. This was repeated for each circuit.

For the Speed of Light lab:
First, the oscilloscope was turned on and adjusted to the correct settings. The probes of channels 1 and 2 were both connected. The power supply was then connected. The plastic fiber was inserted into the fiber optic LED and the detector. Next, the apparatus was calibrated to adjust out the delay of the electronics. The 15 cm length of cable was removed and replaced by a 20 m length of cable. The time interval between the two pulses was measured, and the speed of light in the cable was calculated.