PHY1106:Waves and Oscillations	Dr. Pete Vukusic

Lecture 10.

Lecture objectives.

- To be able to derive the complex equations for the impedance of L, C and R components.
- To understand the significance of the j operator present within the impedance terms for L and C.
- To be able to derive the expression for the complex impedance of a series LCR circuit, and to appreciate how this affects the phase between the current in the circuit and the driving voltage.
- To understand the concept of root-mean-square representation of current and voltage.

Post-lecture tasks.

1. Refer to *Young* (chap. 32) for derivation of rms. expressions for voltage and current.
2. Without using your notes, complete the derivation of the expression for the complex impedance of a series LCR circuit;

i.e. show that it is

$$Z = R + j\left(\omega L - \frac{1}{\omega C}\right)$$

2. Make sure you are familiar with the phases differences associated with each component.

3. An AC supply to a series LCR circuit has V_0=2 volts and is driven at ω=150 rads/s. Calculate the amplitude of the AC current for R=3Ω, L=3H and C=1μF. Draw a phasor diagram showing the phase between the current phasor and the voltage phasor. (Draw the current phasor along the x-axis). To do this you have to calculate the phase difference ϕ At what (resonant) frequency would the current and voltage be in phase?