Outline

• RCL circuit(s)
• Diodes and power supply

Some interpretation & observation

• \( B = -A \frac{\omega}{1/C + \omega L} \)
  like a voltage divider, but it’s as if the resistance (imaginary) is in the opposite directions for \( C \) and \( L \), so the sum = subtraction.
• When \( LC\omega > 1 \) and \( A \) have opposite sign (180° out of phase), and \( LC\omega < 1 \), they are in phase.
• When \( 1/C - \omega L \) (or \( LC\omega \sim 1 \)) \( B \) will be much larger than \( A \) – amplification w/o amplifier!
• This is like forced resonant oscillation.
  – Used in radio (TV) station selection. (\( C \) is variable for a typical radio to tune to various stations.)
  – If \( C \sim 100 \text{pF} \), what should \( L \) be to tune to 1500 kHz?

Dividing by 0?

• When \( 1/C\omega = L\omega \) (or \( LC\omega \sim 1 \)) There is no solution – dividing by 0!
• In reality, there is always some resistance (long coil has large resistance unless super conductor!) in addition to \( L \) and \( C \), so dividing by 0 won’t happen. i.e.
• \( Be^{j\phi} = A jL\omega (1/C\omega + R + jL\omega) \)
  – When \( LC\omega = 1 \), \( Be^{j\phi} = A jR\omega (-A j/R\omega) \)
  – i.e. \( \phi = \pi/2 \) (90° shifted: cosine in, sine out, for example.)

Graphically, minimal resistance

More resistance (damping)

Strong damping
Power Supplies

- Consists of
  - Transformer: transform 110-V AC to 6.3-V AC.
  - Diode: rectify (only one side of sine)
  - Capacitor to remove the "ripples."
- How do they work together?

Transformer

- When there is a coil (inductor), with applied voltage of \( V(t) = V_0 \cos(\omega t) \), then \( N_1 \frac{d\Phi}{dt} = V(t) \), where \( N_1 \) is the number of turns in the coil.
- Now, add another coil on the same core.
- Each turn of the 2nd coil sees \( B \) flux of \( \Phi \)
- Then \( V_{out}(t) = -\frac{N_2}{N_1} V(t) \).

Rectifier (diode)

- It is a short circuit in one direction, and open circuit in the other direction.
- So if 6.3-V AC comes out of the transformer, \( V_D \) will look like:

Rectified signal

- \( V_D = \)
- What does the capacitor do?

Finally w/load (resister)

- When \( V_{out} \) is low, the resister draws charges from the capacitor, so ...

A bit more efficient

- If you have two windings on the 2ndary side of the transformer, this circuit gives you less ripple because