Session 4 Review

Session 4f of Basic Electricity
A Fairfield University E-Course
Powered by LearnLinc

Section 4 Schedule:

Session 4a	– 07/08	Parallel L-C Circuits	Text 4.114 – 4.122
Session 4b	– 07/10	Parallel R-L-C Circuits	Text 4.123 – 4.132
(break for a week)		(no class on 07/15 or 07/17)	
Session 4c	– 07/22	Parallel Resonance	Text 4.133 – 4.146
Session 4d	– 07/24	Tuning and Filters	Text 4.147 – 4.153
Session 4e	– 07/29	Resonant Transformers and Impedance Matching	Text 4.154 – 4.160
Oops, no class	– 08/5-7		
Session 4f	**– 08/12**	**Section 4 Review**	
(Quiz 4 due 08/17)			
	08/17	Section 4 Lab	
Session 4g	– 08/19	Quiz 4 Review	
	– 08/21	MT 2 Review	

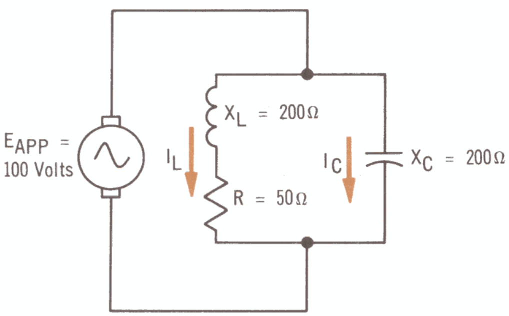
Session 3 (Parallel L-C) Review

- Capacitive reactance $X_C = 1/2\pi fC$ at -90º
- Inductive reactance $X_L = 2\pi fL$ at 90º
- Impedances in parallel add as inverses
  - Adding Vectors
    - Separately add their horizontal and vertical components
    - Graphically: head-to-tail or parallelogram
    - Here the vectors are in opposite directions; they just subtract.
      - Inductive reactance points up (90º)
      - Capacitive reactance points down (-90º)
  - Multiplying Vectors
    - Multiply their magnitudes (lengths)
    - Add their phases
  - Dividing Vectors
    - Divide their magnitudes (lengths)
    - Subtract their phases
- Ohm's and Kirchoff's laws still work with AC

(Parallel R-L-C) Review

- Capacitive reactance $X_C = 1/2\pi fC$ at -90º
- Inductive reactance $X_L = 2\pi fL$ at 90º
- Impedances in parallel add as inverses
- Break the problem down into two simple problems
  - First combine the Inductive and Capacitive branches
    - Here the vectors are in opposite directions; they just subtract.
    - Inductive reactance points up (90º); the inverse points down
    - Capacitive reactance points down (-90º); the inverse points up
    - The larger of the two inverses dominates
  - Now add in the inverse of the resistive branch
    - Find the magnitude (lengths) by using the square root of the sum of squares
    - Find the phases as the angle who's tangent is the vertical / horizontal
- Now just invert again to get the total parallel impedance

A Parallel RLC Example



- First invert the series RL

$1/Z_1 = 1/(50\angle 0^o + 200\angle 90^o)$

$= 1/[(50^2 + 200^2)^{½}\angle \arctan(200/50)$

$= 1/[(50^2 + 200^2)^{½}\angle \arctan(200/50)$

$= 1/(206.2\angle 76^o)$

$= 0.00485\angle -76^o$

$1/Z_2 = 1/(200\angle -90^o)$

$1/Z_t = 0.00485\angle -76^o + 0.005\angle 90^o$

$= .00485*\cos(76)\angle 0^o + .00485*\sin(-76)\angle 90^o + .005\angle 90^o$

$= 0.00117\angle 0^o + 0.0003\angle 90^o = 0.0012\angle 14.4^o$

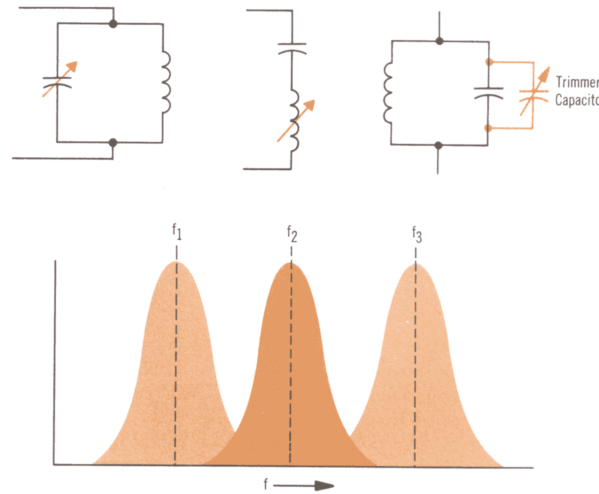
$Z_t = 833\angle -14.4^o$

Parallel Resonance Review

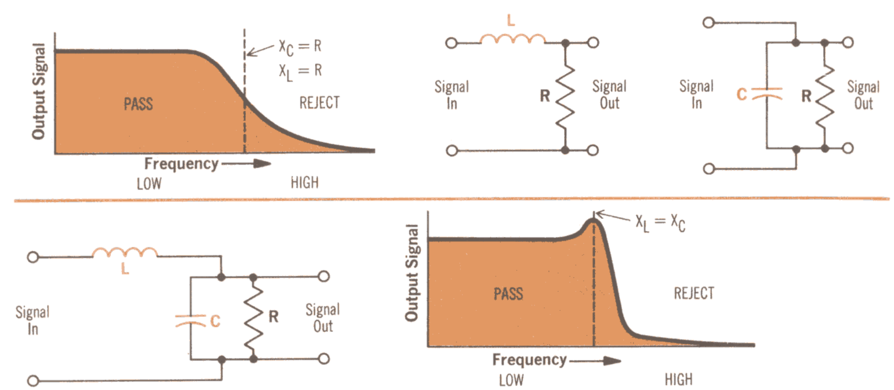
- Capacitive reactance $X_C = 1/(2\pi f C)$ at -90º
- Inductive reactance $X_L = 2\pi f L$ at 90º
- Impedances in parallel add as inverses
- X_L and X_C cancel
- Parallel Resonance
  - High Impedance
  - Low line current
    (high current in the LC loop!)
- Series Resonance
  - Low impedance
  - High line current
- Resonant frequency
  - $2\pi fL = 1/(2\pi fC)$
  - $f = 1/2\pi(LC)^{½}$

Tuning and Filters Review

- Tuning
  - $f_r = 1/2\pi(LC)^{½}$
  - Increasing L or C decreases f_r
  - Decreasing L or C increases f_r
- Filters
  - Low-Pass
  - High-Pass
  - Band-Pass
  - Band-Reject
- T and π Filter circuits



If variable capacitors or inductors are used in resonant circuits, the resonance point and bandpass frequencies can be changed to a variety of frequencies by a simple adjustment.



Resonant Transformer Review

- Transformers
  - Low Load: Inductive currents
  - High Load: Phase determined by the load impedance
- Resonant Transformer
  - Secondary is a **Series** resonant circuit
- Impedance Matching
  - Maximum power transfer: $Z_L = Z_S*$
  - The turns ratio affects the "reflected" impedances.
    - $Z_P/Z_S = (N_P/N_S)^2$
  - A Transformer can then be used to "match" dissimilar impedances (resistive) for good power transfer.

Section 4 Schedule:

Session 4a	– 07/08	Parallel L-C Circuits	Text 4.114 – 4.122
Session 4b	– 07/10	Parallel R-L-C Circuits	Text 4.123 – 4.132
(break for a week)		(no class on 07/15 or 07/17)	
Session 4c	– 07/22	Parallel Resonance	Text 4.133 – 4.146
Session 4d	– 07/24	Tuning and Filters	Text 4.147 – 4.153
Session 4e	– 07/29	Resonant Transformers and Impedance Matching	Text 4.154 – 4.160
Oops, no class	– 08/5-7		
Session 4f	– 08/12	Section 4 Review	
(Quiz 4 due 08/17)			
	– **08/17**	**Section 4 Lab**	
Session 4g	– 08/19	Quiz 4 Review	
	– 08/21	MT 2 Review	