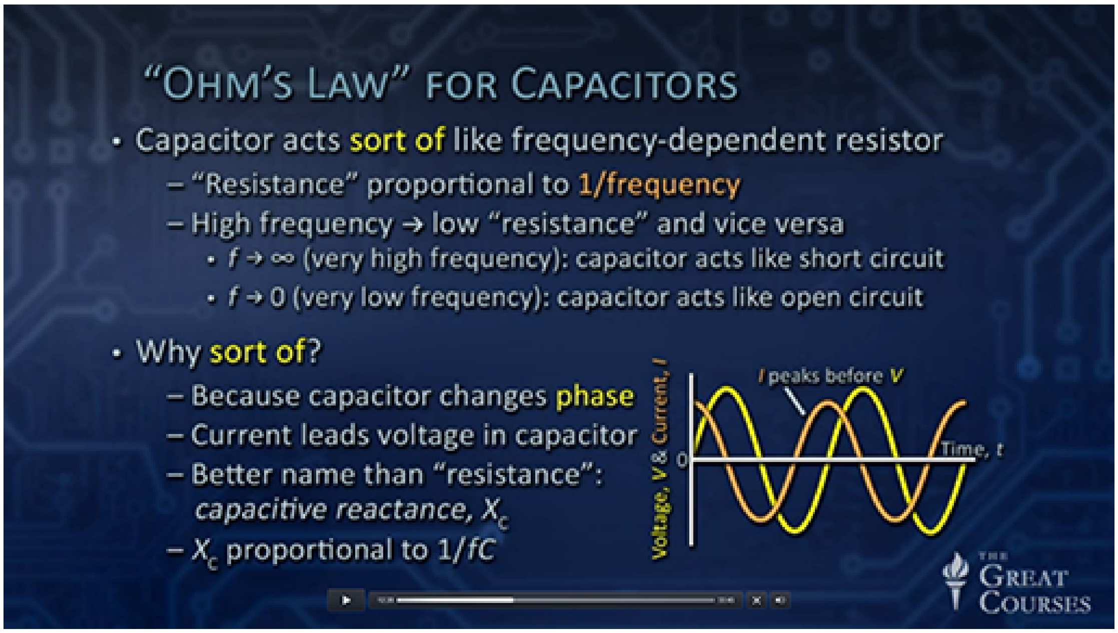
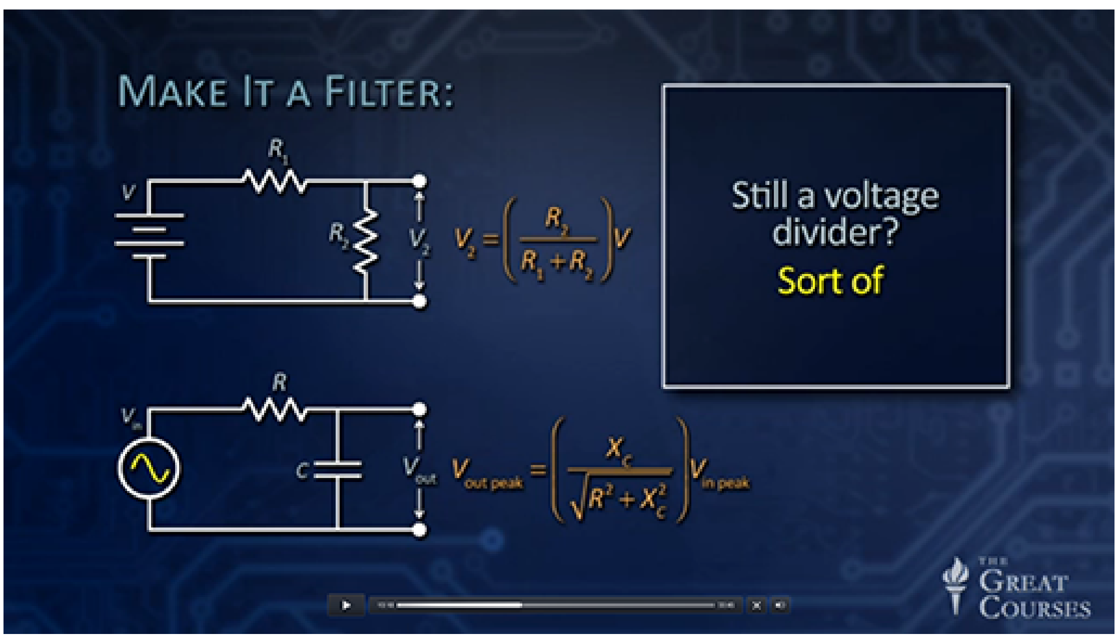
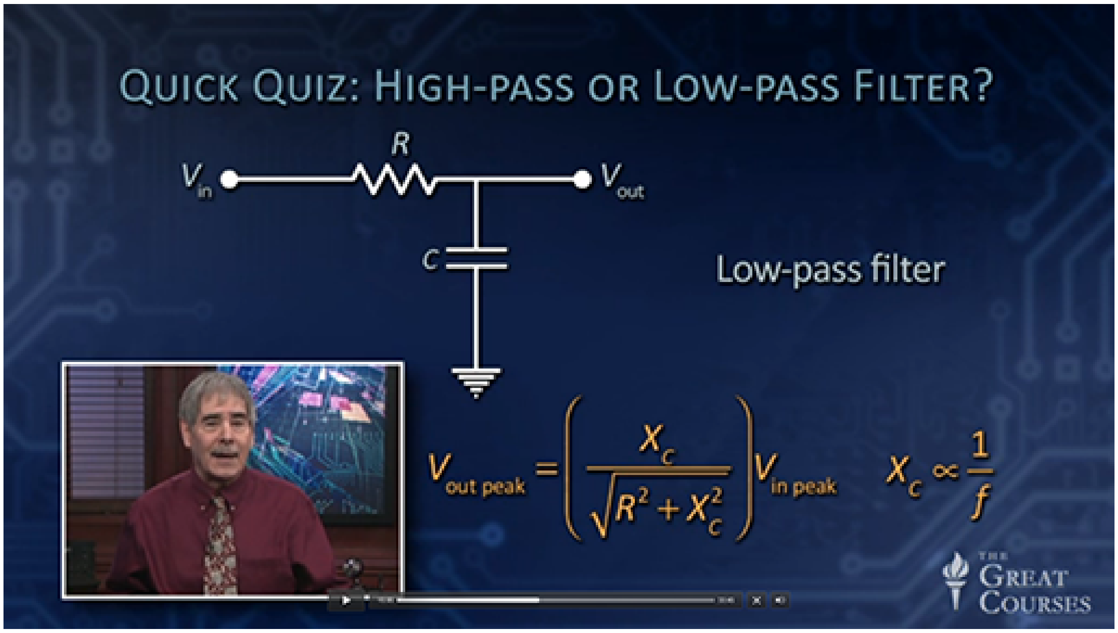
Electronics

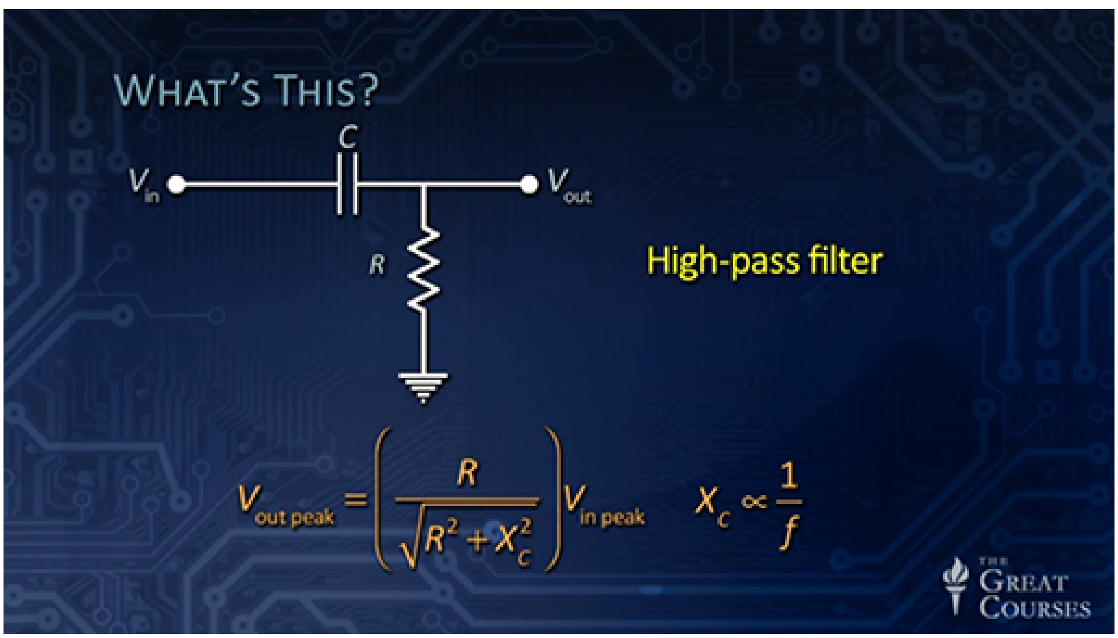
Lecture 5 - Filters



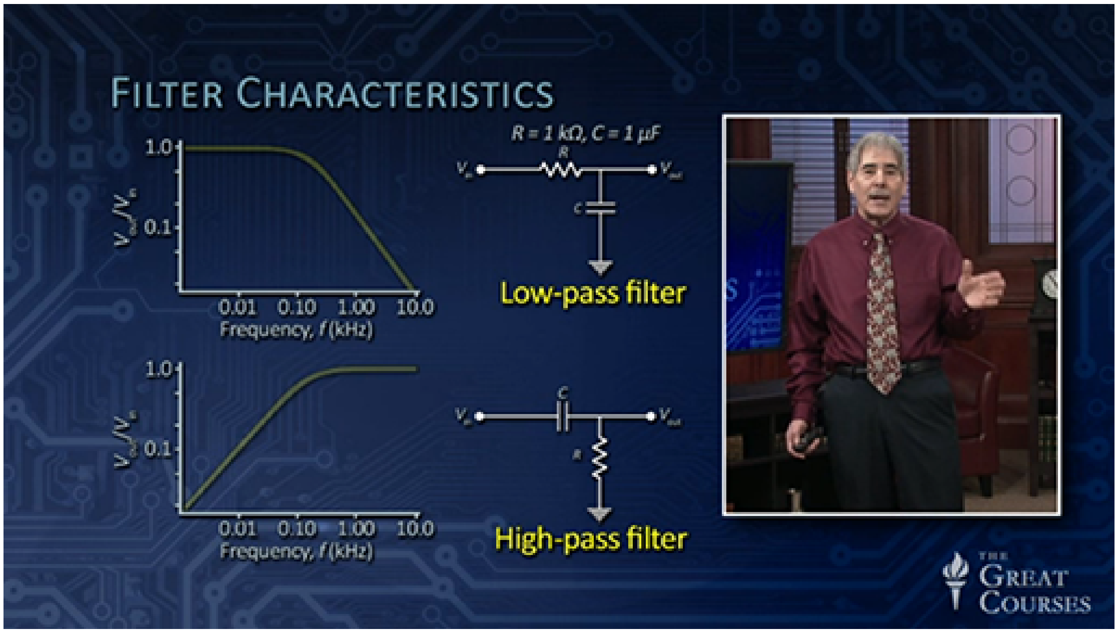




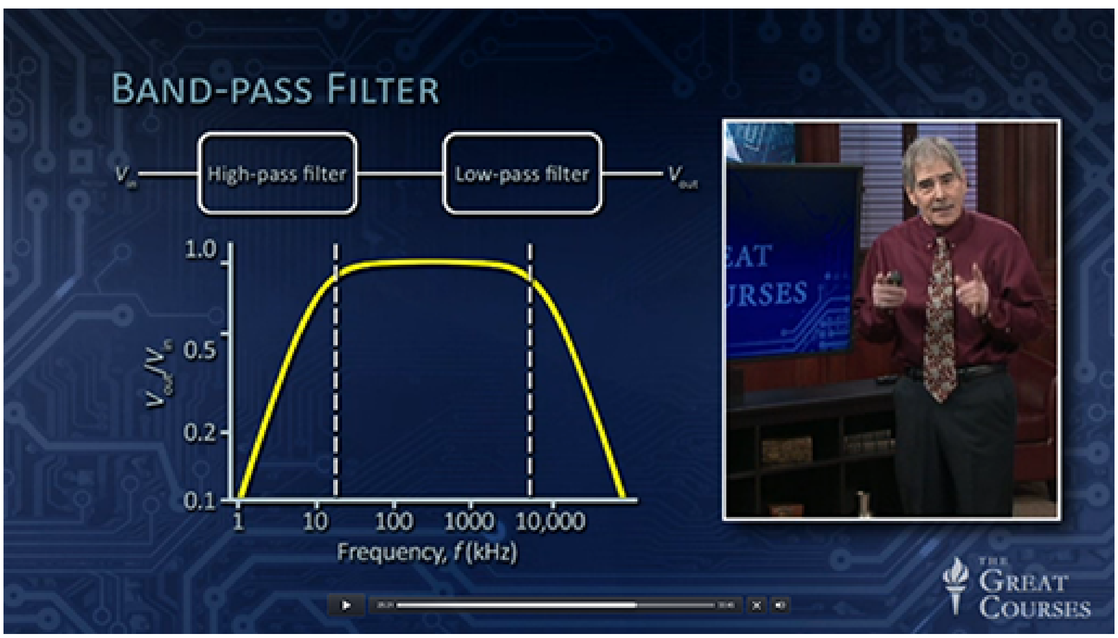
Above: Low pass filter in which the capacitor has high resistance for the low frequencies and therefore they pass through to Vout. This is functioning similar to a voltage divider in which the low frequencies will have very little attenuation, while higher frequencies have little resistance in the capacitor and are therefore filtered out to ground.



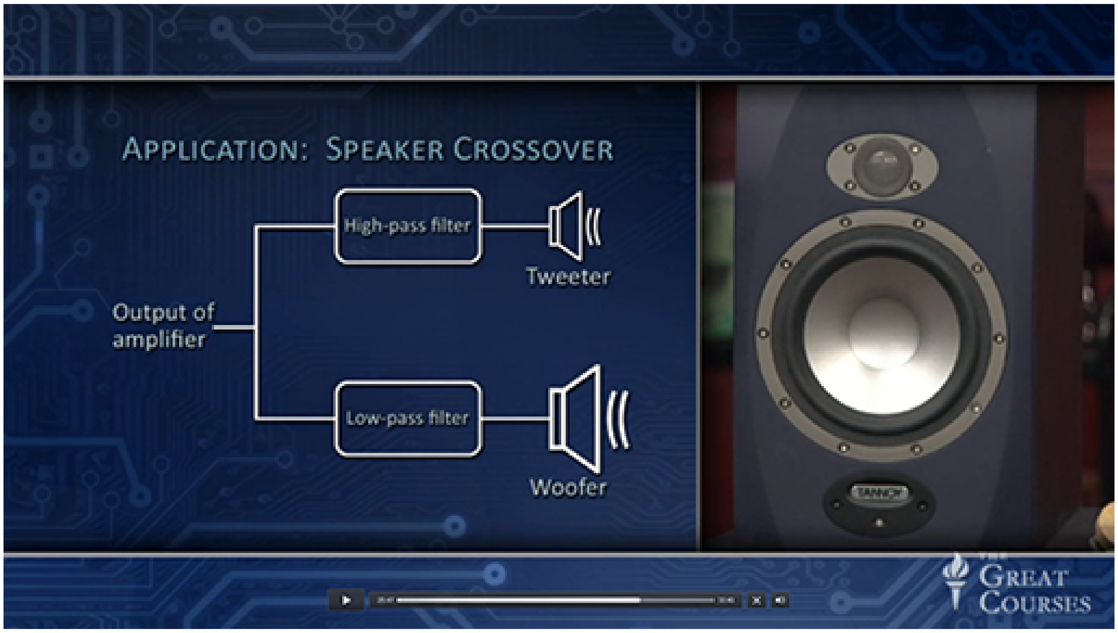
Above: a high-pass filter which blocks the lower frequencies (due to high resistance of the capacitor, but allows the high frequencies to pass (due to low resistance). From a voltage divider perspective the capacitor with its high resistance attenuates the low frequency voltage significantly, while the higher frequencies (and low capacitive reactance) have much less attenuation due to the ratio between the capacitors resistance (capacitive reactance) and the resistor.



Above: A logarithmic plot of the voltage relative to frequency for both low and high pass filters, using a 1K Ω resistor and a 1 μF capacitor.



Above: Band-Pass Filter. Using a high pass filter in combination with a low pass filter, filters out both the high and low freqencies allowing the middle frequencies to pass with much less attenuation.



Application: Speaker Crossover
High-pass filter
Tweeter
Output of amplifier
Low-pass filter
Woofer
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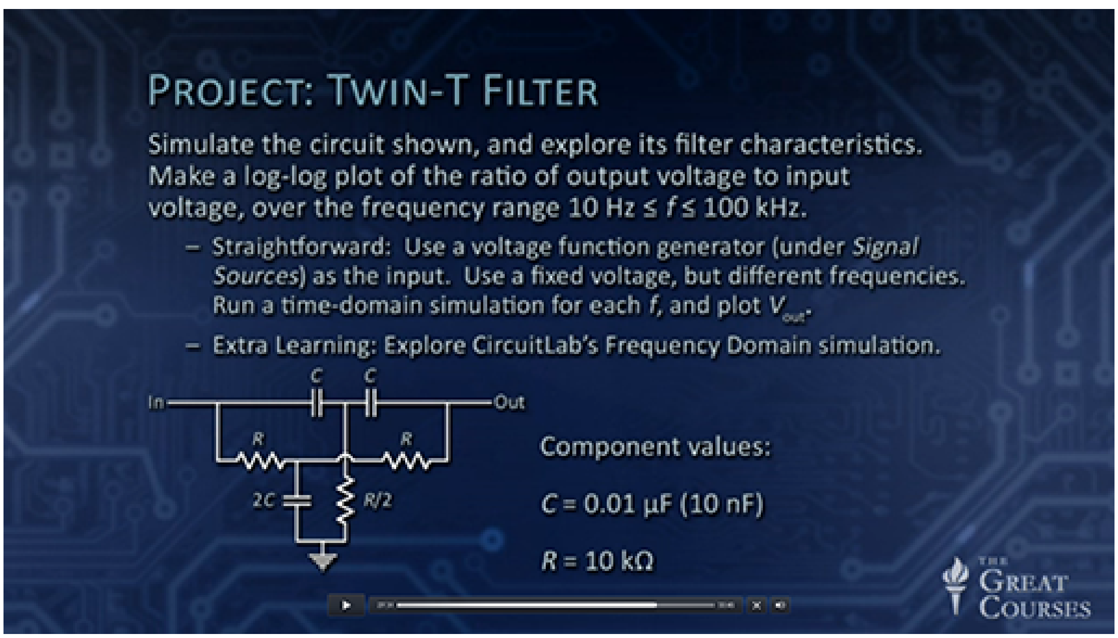
Project



Project: Twin-T Filter
Simulate the circuit shown, and explore its filter characteristics. Make a log-log plot of the ratio of output voltage to input voltage, over the frequency range 10 Hz ≤ f ≤ 100 kHz.
– Straightforward: Use a voltage function generator (under Signal Sources) as the input. Use a fixed voltage, but different frequencies. Run a time-domain simulation for each f, and plot V_out.
– Extra Learning: Explore CircuitLab's Frequency Domain simulation.
In
C
C
Out
R
R
2C
R/2
Component values:
C = 0.01 μF (10 nF)
R = 10 kΩ
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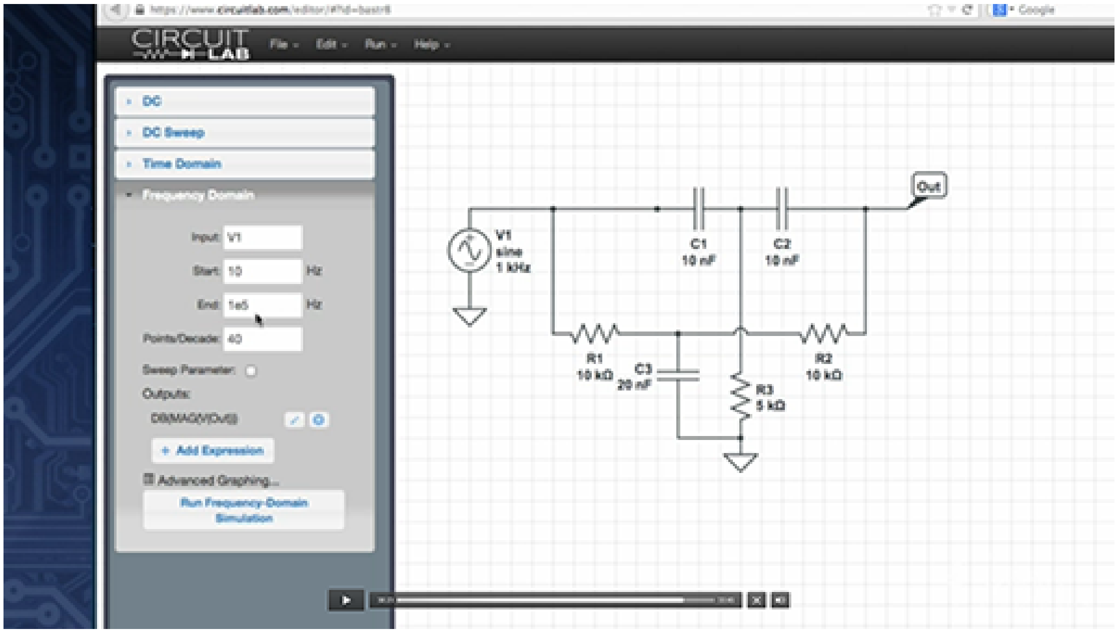
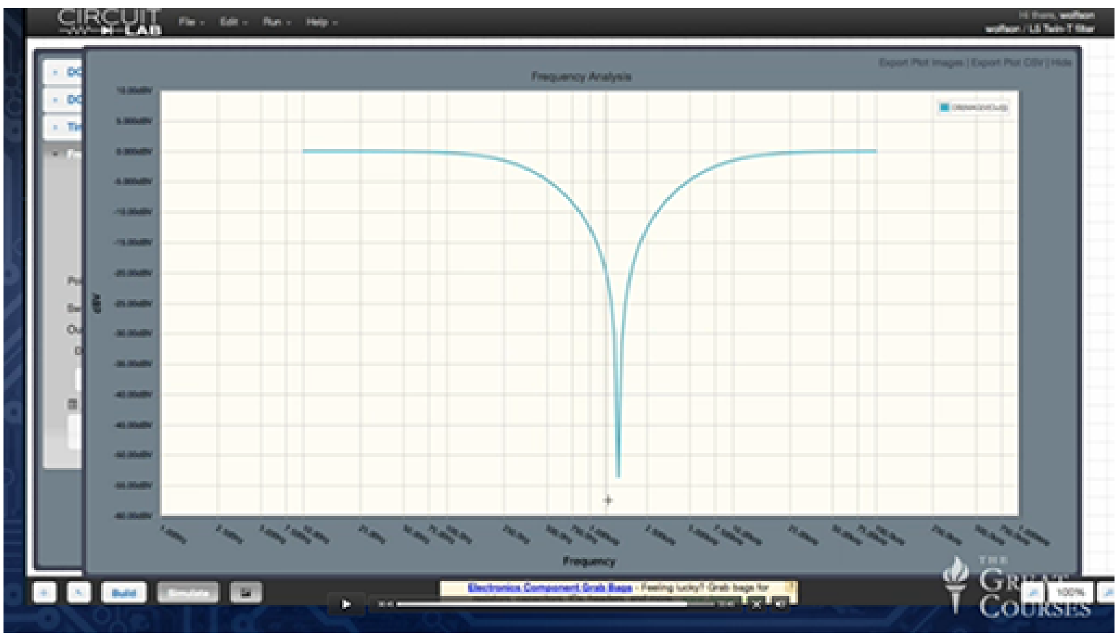

CIRCUIT LAB
File
Edit
Run
Help
DC
DC Sweep
Time Domain
Frequency Domain
Input: V1
Start: 10 Hz
End: 1e5 Hz
Points/Decade: 40
Sweep Parameter:
Outputs:
DB(MAG(V(Out)))
+ Add Expression
Advanced Graphing...
Run Frequency-Domain Simulation
Out
V1
sine
1 kHz
C1
10 nF
C2
10 nF
R1
10 kΩ
C3
20 nF
R3
5 kΩ
R2
10 kΩ


CIRCUIT LAB
File
Edit
Run
Help
Frequency Analysis
Frequency
Build
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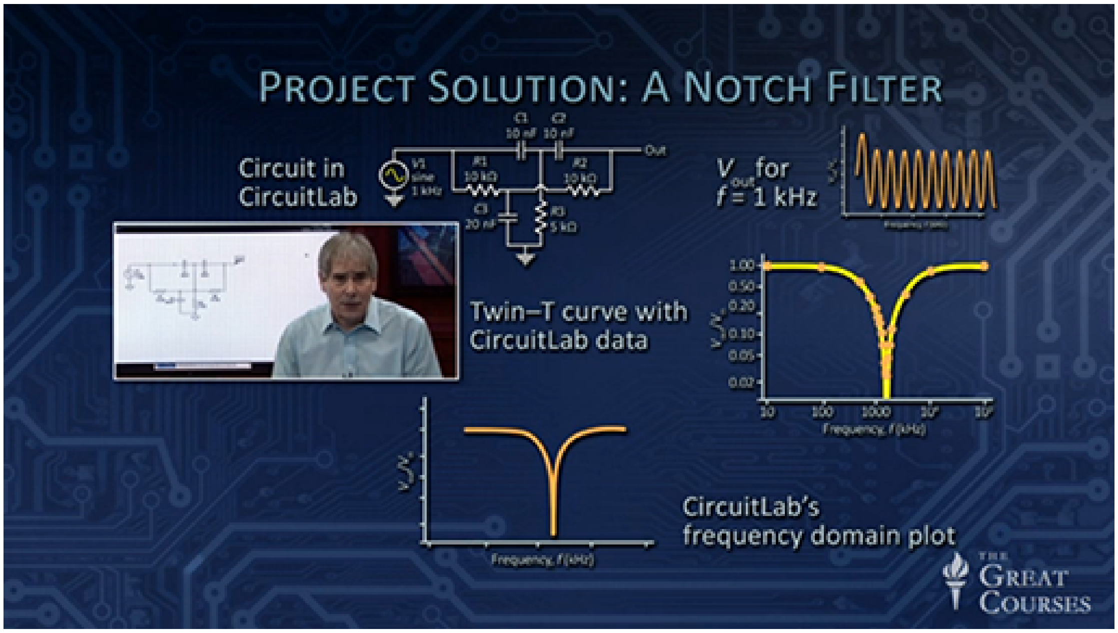
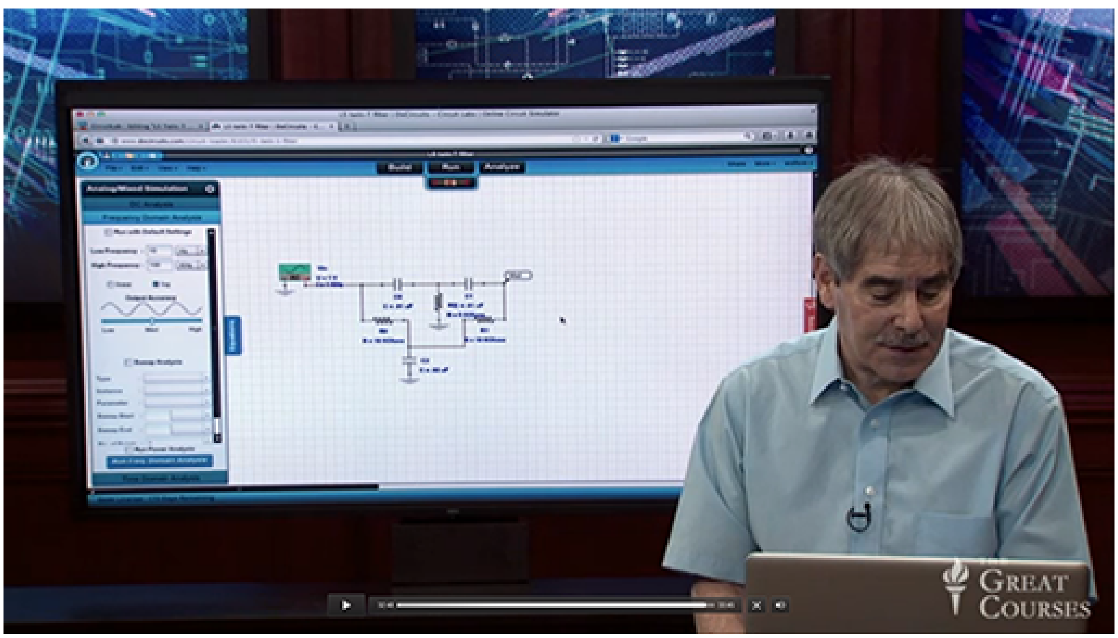


In Docircuit




Build
Run
Analyze
Autofit Graph
Y-Axis Properties
X-Axis Properties
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