

# Solution to ECE Test #12 F03

1. (2 pts) Why is it impossible to actually make a distortionless system?

Because the frequency response would have to extend all the way to an infinite frequency and no real system can do that.

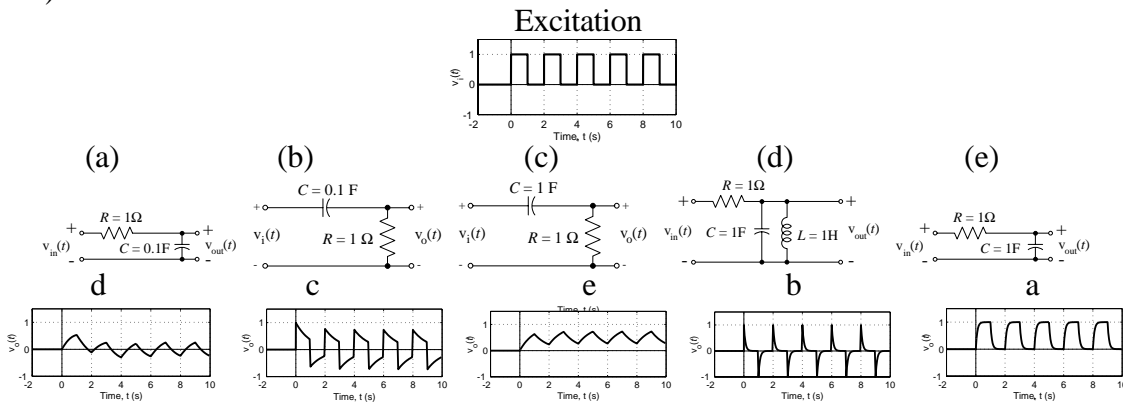
(I also, reluctantly, accepted explanations that inherent random noise processes would cause distortions if they were worded logically. The noise is not actually a part of the filter but an extraneous signal. But because I had emphasized in class that noise is inherent in every system and that the presence of noise alters a signal I accepted, or in some cases, gave partial credit for this kind of explanation.)

2. (2 pts) Why is it impossible to actually make an ideal filter?

Because all ideal filters are non-causal.

(Here I did not accept any “noise” arguments because noise is an extraneous signal which is not part of the filter per se. Also because I had emphasized several times in class strongly that the fundamental reason ideal filters cannot exist is that they are non-causal.)

3. The causal square wave voltage signal illustrated below is the excitation for five practical passive filters, (a) - (e), also illustrated below. The responses of the five filters are illustrated below them in a random order. Match the responses to the filters. (2 pts each)



Circuit (a) is a lowpass filter so the average value of the excitation will be unaffected by the filter and will appear as the average value of the response, while the higher frequency components will be attenuated, smoothing the sharp edges of the excitation. Circuit (e) is also lowpass but, because of its larger capacitance, it attenuates higher frequencies more strongly, smoothing the sharp edges more.

Circuit (b) is a highpass filter so the average value of the response must be zero while the sharp edges in the excitation will be preserved in the response. Circuit (c) is also a highpass filter but, because of its larger capacitance its decay rate is slower.

Circuit (d) is a bandpass filter. Its response must have an average value of zero and it must also attenuate high frequencies so the sharp edges of the excitation will be smoothed.