Introduction to Time–Varying Electrical Networks
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Lecture 40
Analysis of an example LPTV Network- part 2

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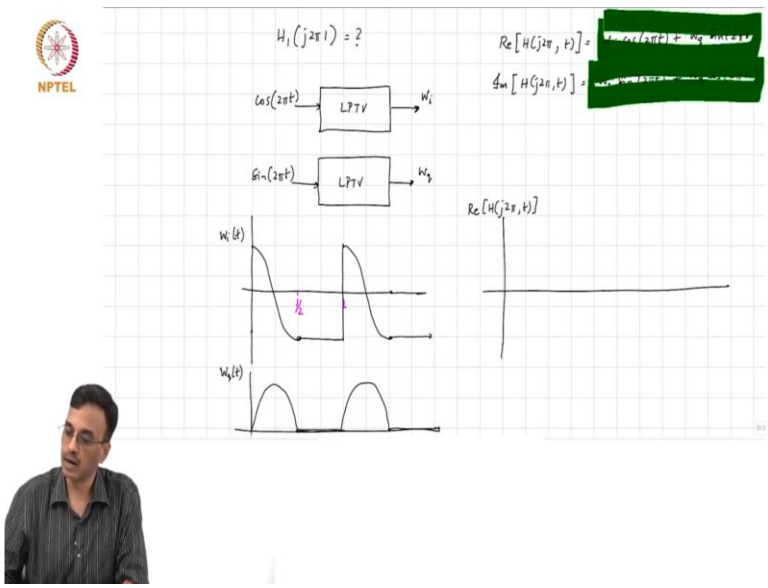

And the question is what do we do about H say 1 of j 2 pi 1? How do we figure this out? Which there are I do not should I give a cos or should I give sin or should I give both? What is the meaning of giving what is j? It is something imaginary. So, we have already covered this extensively in class; so we do two experiments. So, we have this our unknown system, and we give cos 2 pi t; you call this Wi. And then you have sine 2 pi t, you get Wq; and what is real part of H of j 2 pi f comma t? Is nothing but Wi times. Real part of H is?

Student: (())(02:03)

Professor: Wi times cos 2 pi fs times t or by 2 pi fs times t; because I am in this case, I am exciting the input with the I am exciting the system with an input at fs. Does make sense? So, this is cos Wi times, so fs is 1; so, cos 2 pi t plus plus Wq sin 2 pi t. And imaginary part of H is W; W what? i sin 2 pi t minus Wq cos 2 pi t. I am sure this is correct and not look back into your notes is correct; minus must be here and plus must be here. How do so this will because our system is LPTV, what you when you plot this waveform; what do you expect to see? What kind of waveform?

You should get this is nothing, but the gain experienced by the sinusoid. So, the waveforms that you see for real and imaginary part of H will be periodic; and they will periodic with what frequency? Fs. And is that because the input is fed at fs, so what; the input also happens to be at fs. The even if the input was was an arbitrary frequency; you will find that these two will be periodic with with fs.

And that is because the system is varying with the frequency fs; so, so now let us actually do it. So, if we put cos 2 pi f t fs t, how will Wi look like? Let us assume that the g of t is like this; it is very high 0. So, and this goes from 0 to sorry this is half a second I guess right now sorry 2 pi f; this is half a second, this is one second. Yes, so can you please help me plot Wi of t.

Student: (())(05:44)

Professor: It follows.

Student: Follows the cos 2 pi f t.

Professor: Very good, so basically it starts here, it follows you would assume that this is cosine. I am going to get rid of this to reduce clutter and then what happens? Then here the capacity. The switch is open remains flat then what happens again? Does this, remains flat and so on. And what comment can you make about Wq of t?

Multiply this by; this is sin during half cycle becomes 0, sin becomes 0 and so on. But this is not this is not the job done; what do we need to do? To find the real part of H of j 2 pi comma t. What do we do? We need to multiply Wi by cos 2 pi t, which is multiplying Wi by the same waveform. And Wq by Wq by sine 2 pi t; so, what do you think we will have in the first quadrant in the first half second?

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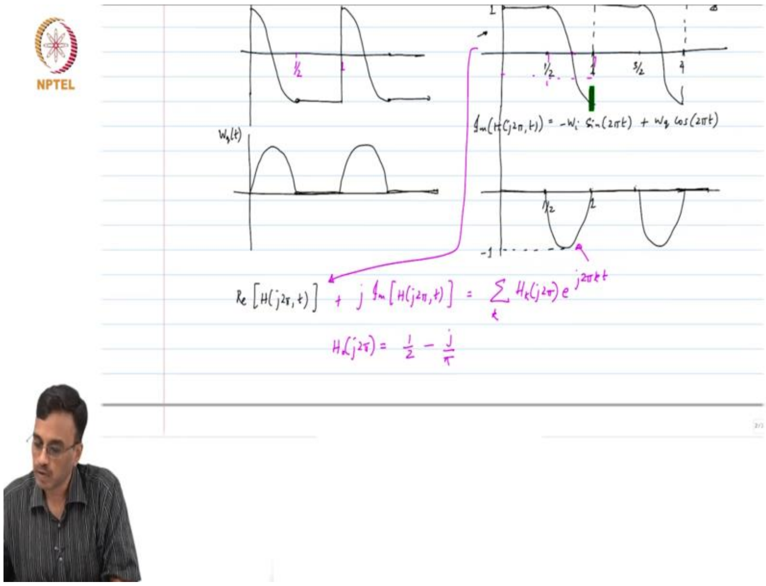

It is nothing but when in the in the first half a second, you have cos square t plus sin square t, sine square 2 pi t. And therefore, that is going to be 1 and what about in the region half to 1? So, Wi times cos. Wq is 0 anyway, so we do not worry about it; so, what happens what comment can we make about this guy now? Minus cos 2 pi. So, that how will that look? That will look like this; that make sense folks; and then again it gets back to, like sense people. And what comment can you make about the imaginary part? Which is minus Wi sin 2 pi t plus Wq cos 2 pi t; all this look like.

So, Wi into sin plus Wq into cos that will simply be 0. In half to 1, it will be Wi is minus 1 will be sin. It is the sorry this this was minus Wi sin 2 pi; so sorry is it negative. So, it is minus Wi cos 2 pi sin 2 pi t, plus Wq cos 2 pi t; and of course, Wq is 0, this in this part. So, Wi is minus 1 minus Wi is 1, so in this it should be.

So, remember this real part of H of j 2 pi comma t is is this waveform here; and you expand this as a fourier series. And you will get some if you do this plus j imaginary H of j 2 pi comma t; what you will get is sigma over k Hk of j 2 pi, e to the j 2 pi k times t. So, H I am sorry I think I have goofed, so basically H0 of j 2 pi is nothing but the dc value of of these waveforms. And what should H0 be therefore? dc by the real part is is half; and dc value of the imaginary part is half minus j by pi. So, let us see if that makes sense.

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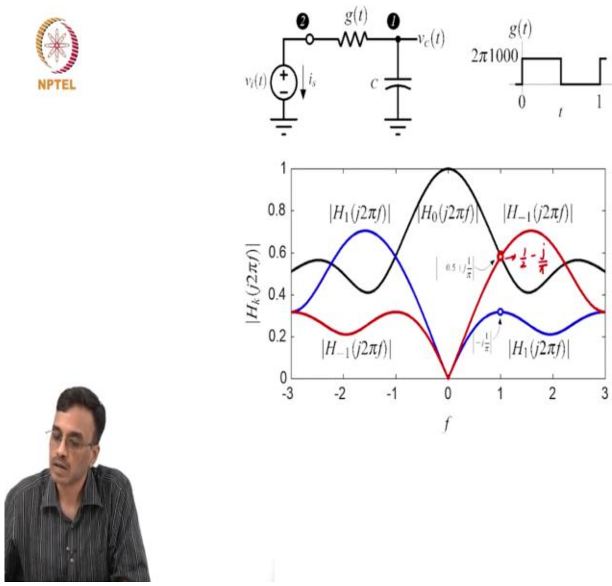

So, it is this is this value here, it happens to be half minus j by pi. Now, H so the magnitude is what you call? Square root of one fourth plus 1 by pi square. Now, the next thing I would like to draw your attention to the following.