Introduction to Time - Varying Electrical Networks
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Lecture 57
Why is the transfer-function theorem important?

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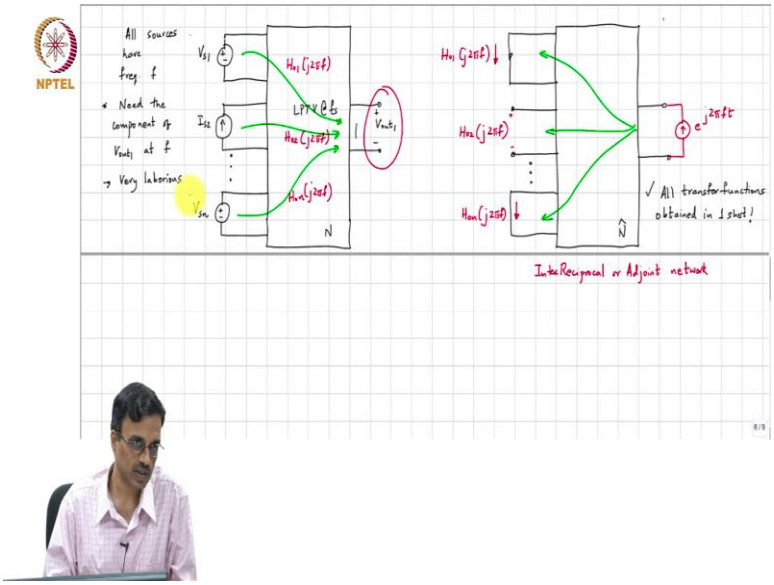

Now, why is the transfer function theorem so important? Again, the reason is very similar to what we had when we discussed a time invariant network. So, let us say this is LPTV at fs, this is N and let us say you had multiple sources. So, let us call this e to the j, let us call this v s1 let us call this I s2, blah, blah, blah you have multiple sources and you have 1 output.

And so let us say this is v out 1 and so let us say, so V sn let us say, so and all these let us say all sources have frequencies some f. So, the output is to find the output at f what would we do, what would we have to do normally if we did not know about reciprocity? So, basically what we would do, would be apply superposition at you analyze the network one source at a time and you find the transfer function from V s1 to the output, find the transfer function from I s2 to the output, we find the transfer function from V sn the nth source to the output and that is a very laborious process.

And we basically let us say need the component of v out 1 at f. And this is a very laborious process. So, what one can do is use reciprocity. What do we do with reciprocity? We, if we call this, if we call this transfer function H0 1 of j 2 pi f, this is H0 2 of j 2 pi f, this is H0 n of j 2 pi f

which are the zeroth order harmonic transfer functions corresponding to the first, second, third, all the way up to the nth source.

Now, what are we going to do? Instead of doing this by superposition and doing the analysis n times what we will do is exploit reciprocity, what do we apply? We apply a current source at the output at f, so e to the j 2 pi ft and this current is going to be H01 of j 2 pi f, this voltage is going to be H02 of j 2 pi f and this is going to be H0 n of j 2 pi f.

So, this is the reciprocal or inter reciprocal I must say or equivalently the adjoint network, you excite the output port of adjoint after following all the element replacement rules and in one shot you are able to get all the transfer functions. So, this is a all transfer functions obtained in one shot, all that makes sense?

Very good, so now the, so in other words we are in I mean, remember the reason we are looking at the output frequency I mean we are looking at the output frequency, the output voltage with the frequency component of f but this is an LPTV network so it is not merely, no, no, no, it is of course it is not a single frequency at the output and it is also not that the output at f is only because of the inputs at f, if these sources vs1, vs2, vsn had components at f plus some l times fs, they will also translate to the output at frequency f.