Nonlinear System Analysis
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Lecture - 35
Dissipative Equality for circuit (contn'd)

So, in the last class we I was trying to motivate what we mean by passive circuits, and the sort of conclusion that we arrived at was that, passive circuits is something where the amount of energy that is supplied to the circuit this is always positive. And the amount of energy that is supplied to the circuit is bifurcated in two ways; a part of it goes into stored energy, which gets stored by the energy storage storing elements in the circuit and the other part gets dissipate ok.

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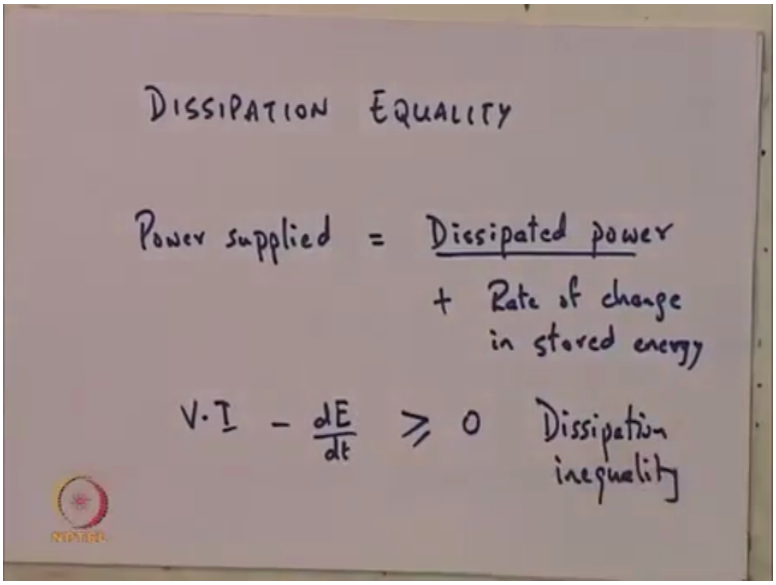

So, let me write out an equation that sort of captures this idea of passivity. So, this equation is what is called dissipation equality. And, what it says is that power supplied is equal to dissipated power, plus the rate of change in stored energy. Well, as far as dissipated power is concerned, this dissipated power is always going to be something which is positive. Therefore, I could take this rate of change in stored energy to the other side and I can always say that power supplied minus the rate of change in stored energy is some quantity which is always going to be positive.

Now, in case of a circuit of course, what we can do is we can write this down the power supplied is V dot I and. So, this stored energy is denoted by E then d E d t. So, V I minus d E d t is greater than equal to 0, this greater than or equal to 0 essentially this is in fact, equal to the dissipated power and the dissipated power is always positive quantity. So, V dot V dot I minus d E d t is greater than equal to 0 this in fact, is called the dissipation inequality and this dissipation inequality is always going to whole true for circuits which are passive ok.

Now, how do we characterise circuits which are passive? Ok. Now, importantly the circuit the examples of the circuits that we were looking at it has one input and one output and typically in circuits the number of inputs is equal to the number of outputs, because we think of circuits in terms of ports and each port has a voltage and a current. And so, one of them either the voltage or the current you think of is the input and the other one is the output. And so, the circuits are the special kinds of systems where the number of inputs is equal to a number of outputs.

So, of course, till now in the example that we were looking at it was a single inputs, single output case, but you could also look at a multi input, multi output case. Where, you have a whole vector of voltages and currents of various ports forming the input and another whole vector of the corresponding currents and voltages on those ports as the output.

And then just like we talk about V dot I you could just talk about the inner product of the input and the output giving you the energy supplied and there would be storage function

depending upon the number of depending upon the various energy storing elements which are there in the system.

And one could write out the dissipation inequality which says that the inner product of the input and the output minus the rate of change of the stored energy this is always going to be greater than equal to 0. Because, this quantity in fact is going to be the dissipated power and the dissipated power is always a positive quantity.