DC Power Transmission Systems
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Lecture – 41
6 pulse LCC with resistance, inductance and voltage source on the DC side: Part 1

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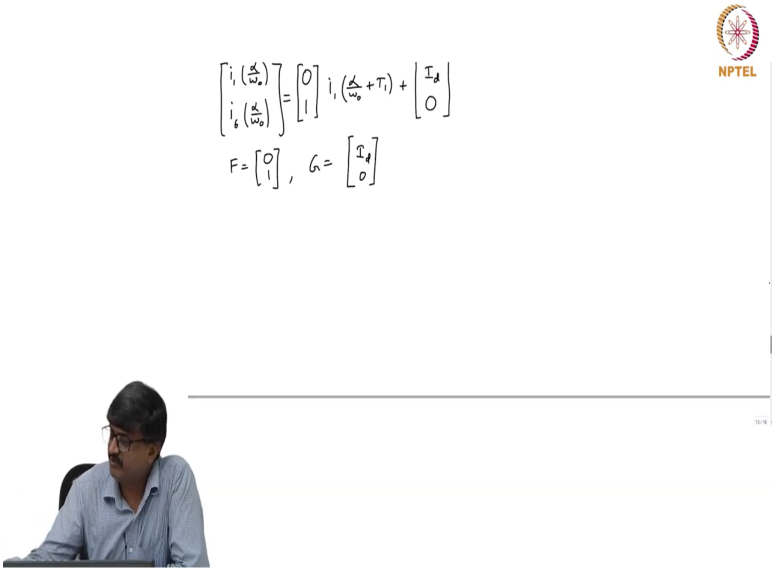

Now one can how more complicated circuits. So, the method actually is useful only for more complicated circuit. So, if I have on the DC side something other than a current source then it becomes more complicated.

Now, let us look at one circuit which is actually more complicated than the circuit, so we have seen so far.

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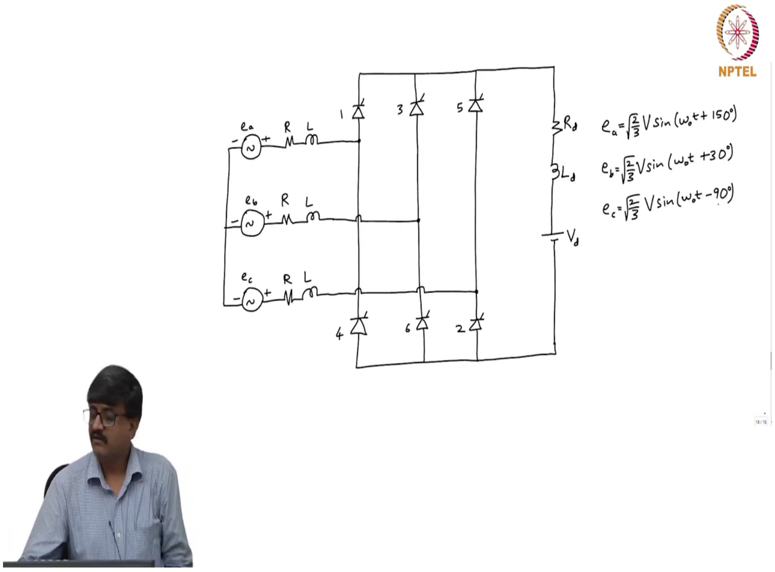

So, the circuit I am considering now is on the AC side I have a 3-phase balanced voltage source. In each phase there is a resistance and an inductance; valves 1, 3, 5, valves 4, 6, 2.

Now, on the DC side, we consider a model consisting of a resistor, an inductor and a voltage source a DC voltage source. So, V d is the voltage across this voltage source, R d is the resistance, L d is the inductors. So, we have the same expressions for e a, e b, e c which we have been using root 2 by 3 V sin omega o t plus 150 degrees, e b is root 2 by 3 V sin omega o t plus 30 degrees and e c is root 2 by 3 V sin omega o t minus 90 degrees.

So, if I want to analyze this circuit. So, I can imply the general steady state analysis. So, let us try to do the steady state analysis; so, essentially finding x 1, x 2, a 1, u 1, a 2, u 2, f g. So, let us start with the 2 and 3 valve conduction mode.

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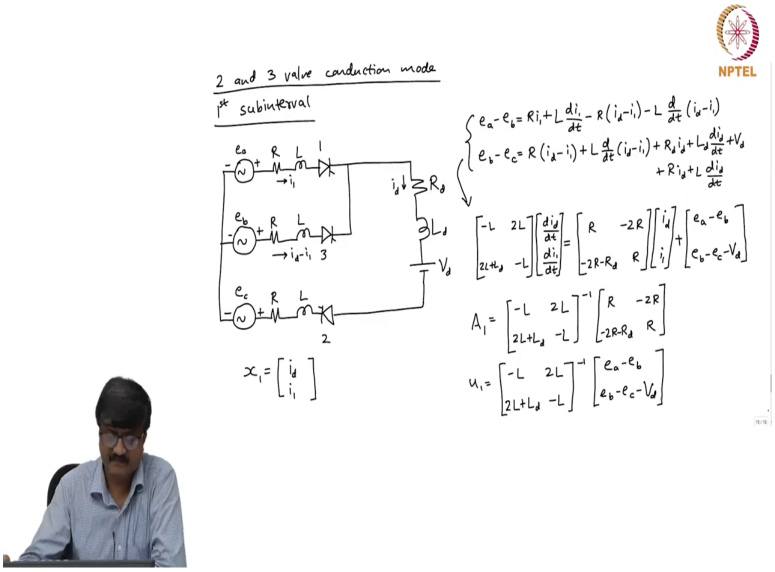

So, if I take 2 and 3 value conduction mode; so, if I take the first sub interval. So, there are 3 valves conducting in the first sub interval. So, I will show only those valves that conduct current. So, the equivalent circuit is like this. This valve 1, valve 3 and valve 2. This is i d, sorry. We have a different circuit now on the DC side, so I have a resistance inductance and a voltage source. So, this is R d, L d, V d. So, how many elements are there in the state vector x 1?

This is unlike the previous circuits where there was a constant current on the DC side. So, there is no longer a constant current or if I consider the current instantaneous current i d it is not necessarily a constant. So, we cannot actually ignore the slope while I mean we have to include this loop consisting of R d, L d, V d also in the equations.

So, if I take x 1, then what are the elements of x 1? So, there are two loops, so there should be two elements. The first element is i d and the second element is nothing but the current in the outgoing valve, the current the outgoing valve is nothing but i 1, value 1 is outgoing valve. So, i d and i 1 are the elements of x 1.

So, let us try to write the equations for the circuit by applying Kirchhoff's voltage law and once we bring it to the standard form, we can get A 1 and e 1. So, if I take the loop consisting of e a, e b R and L in series with a R and L in series with e b and valves 1 and 3, then I have by Kirchhoff's voltage law e a minus e b is equal to R i 1 plus L di 1 by dt. So, if I take the current here this is i d minus i 1, minus R i d minus i 1, minus L d by dt of i d minus i 1.

If I take the loop consisting of e b, e c, R and L in series with e b, R and L in series with the e c, the valves 3, 2, R d, L d, V d. So, if I take this loop and apply Kirchhoff's voltage law, I get e b minus e c is equal to R into i d minus i 1 plus L d by dt of i d minus i 1, plus R di d plus L d d id by dt plus V d and the current through valve to R and L in series with e c is nothing but i d plus R id plus L di d by dt.

So, these are the two equations. So, we can write these equations in the standard form. So, I will write this as a equation in the vector metrics form. So, I will take the terms involving the derivative of the state variables, so di d by dt, di 1 by dt. So, let me first consider the terms involving di d by dt and di 1 by dt, in these two equations, ok.

So, in the first equation if I take the coefficient of di d by dt. So, there is a L di d by dt with a negative sin, so minus L di d by dt. And if I look at the coefficient of di 1 by dt, so there are two terms in valve I mean 2 times L d by dt is appearing twice. So, 2 L is coefficient of di 1 by dt.

If I look at the second equation the coefficient of di d by dt. So, I have L did by dt plus L d di d by dt [inaudible] plus L di d by dt, so it is 2 L plus L d. So, 2 L plus L d is the coefficient of did by dt. Then the coefficient of di 1 by dt is minus L d. So, I will equate this to the remaining terms on the other side. So, first I will take the terms involving i d and i 6. So, in the first equation the coefficient of i d is R, the coefficient of i 6 is sorry the coefficient of this is i 1 sorry, sorry. So, the coefficient of i 1 in the first equation is minus 2 R. In the second equation the coefficient of i d is 2 R plus R d with a negative sign. So, it is minus 2 R minus R d. And the coefficient of i 1 is R.

Then there are other terms in both equations. So, in the first equation I have e a minus e b. In the second equation I have e b minus e c minus V d. So, if I pre-multiply this equation by the inverse of this square metrics on the left hand side I get the equation in the standard form, so from that I can get A 1 and U 1. So, I can write A 1 as minus L, 2 L, 2 L, plus L d minus L; inverse R, minus 2 R, minus 2 R, minus R d, R. So, this is A 1. And u 1 is minus L, 2 L, 2 L plus L d, minus L; inverse e a minus e b e b minus e c minus V d.