Computer Aided Power System Analysis
Prof. Biswarup Das
Department of Electrical Engineering
Indian Institute of Technology – Roorkee

Lecture - 59
Fault Analysis (Contd.)

Hello friends. Welcome to this lecture on computer aided power system analysis. We have been looking into the aspect of transformer modeling. In the last lecture, we have looked into the modeling of YgYg transformer of corresponding to two different vector groups. Today, we would be looking into the aspect of modeling in Ygy transformer.

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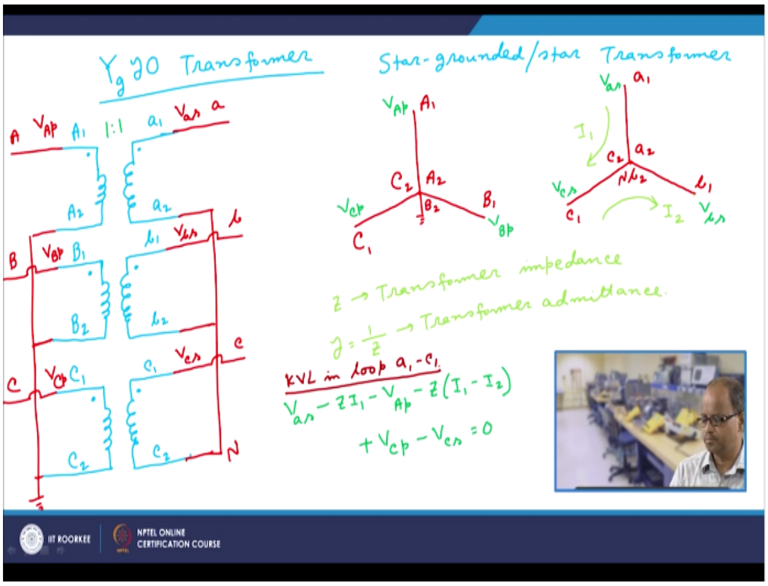

So therefore today what we are going to do is modeling of Ygy transformer, so it is Ygy transformer, so let us say Ygy0 transformer. So that means it is basically star-grounded star transformer and there is no phase difference between the phase A voltage of the primary side and the phase a voltage of the secondary side. So then therefore, we again draw, so we have got as we have done so have got 3 winding, as you have done in the earlier case you are doing exactly the same case.

So I have got A1 A2, B1 B2, C1 C2 then small a1 small a2, small b1 small b2, small c1 small c2 and the dots are here, here, here, here, here and here. So as usual this is star-grounded, so this is phase A, this is phase B, this is phase C and because this vector diagram would be the same, so we have already seen so then obviously we also have to star ground them but only difference is that they will not be grounded.

So you are creating a star connection but they will not be grounded. So this is phase a, this is phase b, this is phase b, this is phase small c. So the voltage let us say we denote that it is VA now and VB and VC. Now it is V small c, it is V small b, it is V small a. To distinguish between the primary side and secondary side, we can possibly write VAp, VBp, VCp and let us say this is Vas, Vbs, Vcs.

Otherwise, sometimes this capital C and small c they are not (()) (04:33) recognizable with each other. So the current is IA, IB and IC etc. So now we draw the vector diagram. Vector diagram we already know, so this is grounded, this is A1 A2, this is B1, this is B2, capital C1, capital C2 and in the secondary side also we have got the same. So this is a1 a2, b1 b2, small c1 small c2.

Only difference is that that this point is not grounded. So now the point is that how do we calculate the current? Now in the earlier case, when this was grounded and when this was grounded, so then we could only say that essentially the voltage across this particular winding is VAp only but here in this case the voltage across this winding is not equal to Vas, it is actually VA1-VA2.

So then therefore, if I say that this point is neutral so it is actually VA1-VN, similarly the voltage across this is VB1-VN and then similarly the voltage across this winding is actually VC1-VN but here we do not know what is the capital N, we just do not know what is capital N. So then therefore, what we can do is so then therefore we really cannot write that IA is=VCp-Vcs/z and etc.

So then so to get around this problem what we do is we take some circulating current like this let us say I1 and we take some circulating current like this say I2 at the secondary side that is at the y side and we also say that z is the transformer, small z is the transformer impedance. So then therefore we can say y is=1/z is transformer admittance. Now what we will do is so let us denote these potentials, so these potentials are Vas, Vbs, Vcs and this is say VAp, VBp, VCp.

Now we would like to write down the KVL across this loop, so then if we consider this loop so then what will happen? Now in this loop, if I start from this point and if I go to this point, what are the electrical quantities we will get? Now when I go in this direction, so then we get the equation Vas, so this voltage-the drop due to this current I1, so z*I1 and there also would be a drop.

Now because these two windings are actually magnetically coupled with each other, so then therefore when we would travelling in this direction, we will also get one reflected voltage here, so then therefore that reflected voltage will also be from this to this. So then therefore, this reflected voltage would be VAp. Here we are assuming that this is 1:1 transformer, so VAp. So Vas-this drop and then the voltage drop due to this reflected voltage of the primary side to the secondary side.

Then, we are moving in this direction and in this direction what is the amount of current in this direction, in this direction the current is I1-I2, so it is minus, so then the drop is z I1-I2 z-I1-I2 then –the drop in this direction due to the voltage, due to the voltage corresponding to this branch. Now here when you are moving in this direction, so then therefore we are here encountering the C phase, so then therefore here also you will be encountering C phase.

But then this potential VCp is actually from this to this, so then therefore when we would be moving from this side to this side here, it would be actually rise so then it would be VCp right, so it would be VCp and then –Vcs is=0. I repeat, so then therefore we start so as if at this point as if that time there is a rising voltage Vas-the drop and this is nothing but the impedance drop due to the flow of current I1 in this branch that is zI1.

Then, there will be another drop due to this reflected voltage of phase A, see this is phase A and this is phase a. Then, there is another drop because in this direction net current is I1-I2, so then therefore there is a drop z*I1-I2. Now the reflected voltage of the primary side of phase C is actually from this side to this side, so then therefore when you are moving from this side to this side, it would be nothing but a rising voltage.

So then we will get VCp and then of course then it will be the drop Vcs. So this is the equation. So this equation is actually you should actually write that KVL in loop a1-c1, so we are writing KVL in loop a1-c1.

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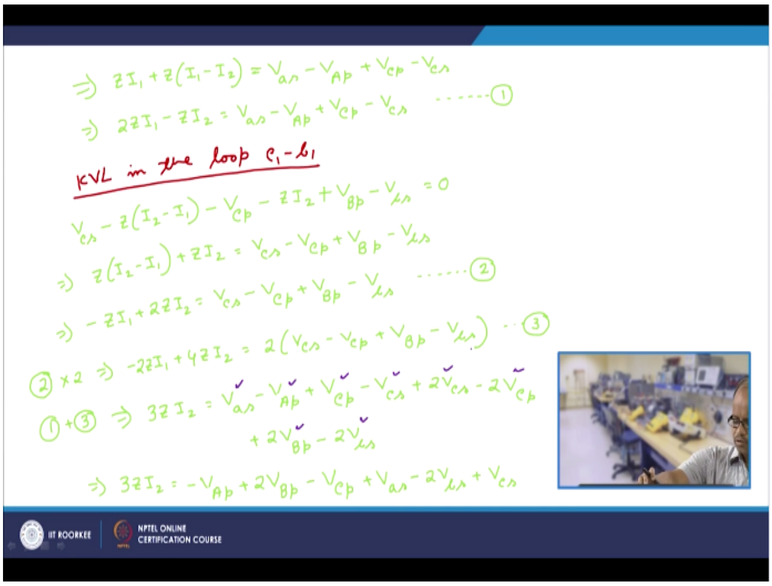

So then therefore we can write down the equation as from this you can write down that zI1+zI1-I2 so zI1+z*I1-I2 is=Vas-VAp+VCp-Vcs or in other words it is 2zI1-zI2=Vas-VAp+VCp-Vcs. So this is equation number 1. Now we consider another loop. Now we consider the loop c1-b1. So now we write the KVL equation in the loop c1-b1. So we write KVL in the loop c1-b1.

So when I write down the KVL in the loop c1-b1, so we start from this point and we reach at this point. So when we start at this point, so my voltage is Vcs so my first voltage is Vcs. Then, the current in this direction is I2-I1, so then the drop due to the current in this direction is zI2-I1. So then the drop z*I2-I1, then there would be a drop due to the reflected voltage of phase C here.

So then this reflected voltage is also from this point to this point and then essentially the instantaneous polarity of this reflected voltage would also be from this point to this point. So there will be –VCp so it is –VCp. Then, the drop when the drop in this direction in this branch the current is only I2, so then the drop is –zI2, so –zI2. Then, now we should also have now here in this branch the reflected voltage is VBp.

But again this VBp is actually rising from this point to this point, so then therefore the reflected voltage here at this branch would also be rising from this point to this point. So then therefore, this is a rising voltage, so then therefore it should be +VBp and then -we reach this voltage –Vbs is=0 right. So it is –Vbs is=0, so then therefore we write zI2-I1+zI2 is=Vcs-VCp+VBp-Vbs.

So then therefore –zI1+2zI2 is=Vcs-VCp+VBp-Vbs is equal to so this is the second equation. So now what happen, so you have got so now therefore what you have done so far because at the secondary side I do not know this voltage of this point N, so this point is N or b2 the same. So we have created two-loop current I1 and I2 and by writing KVL equations in two loops, so we have got two loop equations.

These loop equations are given by 1 and 2. So now we need to solve these two equations and find out the expression of I1 and I2. So to do this, so what we do is we do multiplication of 2 x 2 so now is actually -4I1 it is -2zI1+4zI2 is=2*Vcs-VCp+VBp-Vbs. So this is equation 3. Now we do 1+3, if we do 1+3 so then what happens, this this cancel out and this becomes 3zI2 is actually Vas-VAp+VCp-Vcs+2Vcs-2VCp+2VBp-2Vbs or in other words 3zI2 will be now take all these things common.

So what we get, Vas-2Vbs so first –VAp+2VBp and so it is I have got –VAp+2VBp-VCp+Vas then -2Vbs+Vcs. So again let us cross check so let us cross check this VAp+2VBp-VCp+Vas then -2Vbs and +Vcs.

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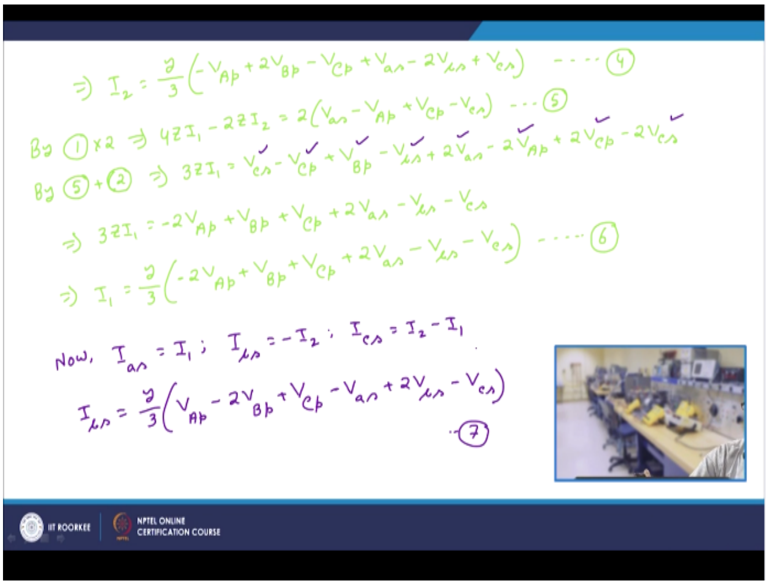

So then therefore I2 is=y/3*what is y/3, y/3*what is y/3? y/3*(()) (20:42) –VAp+2VBp-VCp when writing all of them +Vas-2Vbs+Vcs. So this is the expression of I2. So let us so this is the equation. So I have got the expression of I2. Now we have to also get the expression of I1. So to get the expression of I2, what you do is we multiply this equation by 2, so by equation 1*2 so what does it give us, this give us 4zI1-2zI2 is=2*Vas-VAp+VCp-Vcs so this is also equation say 5.

Now what you do is we add 5 and 2, so if I add 5 and 2 so what you get is if I add 5 and 2 so we do by 5+2 so what you get so 5 and 2 we get is 3zI1 is=Vcs-VCp+VBp-Vbs+2Vas-2VAp+2VCp-2Vcs. So then therefore what we get is 3zI1 we collect everything first we collect VAp so when we collect VAp so we get -2VAp there is only -2VAp so -2VAp+VBp so -2VAp+VBp and then +VCp and then what we get is +2Vas and then what we get is –Vbs and –Vcs. Let us cross check.

So let us cross check, so cross check with -2VAp that we have got, +VBp that we have got, +VCp this and this +2VCp, 2Vas so this gives me 2Vas, -Vbs this gives me -Vbs and only this two are remaining, everything else has been taken care of so these two remaining –Vcs so then therefore I1=y/3 -2VAp+VBp+VCp-2Vas-Vbs-Vcs, 6 and 4 are the equations of I1 and I2. So with these equations of I1 and I2, now we are ready to write down the equation.

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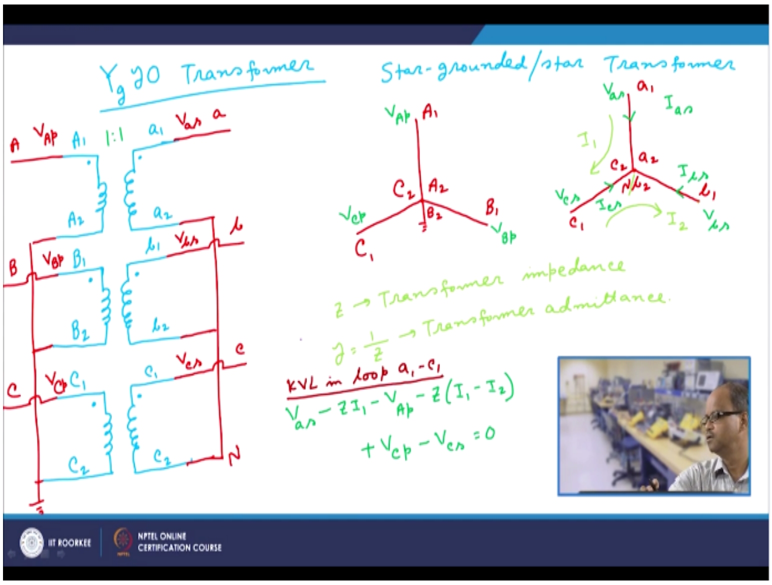

Now from here what I can do, now I a1 or rather I small a or now let us say that these currents are denoted as now let us say these currents are denoted as let us say Ias, this current is Ias, this current is Ibs, this current is Ics. So this current is Ibs, this current is Ics, this current is Ias. So then therefore what we can do write Ias is=I1. So now from this equation I can write down that now we can write down Ias is=I1, Ibs is=-I2 and Ics is=I2-I1.

So then therefore Ias is=I1 is this, Ibs is=-I2 so then Ias is equal to so then therefore Ias is=I2-I1. So Ibs is actually is=-I2 so then therefore y/3 *VAp-2VBp+VCp-Vas+2Vbs-Vcs. So this is equation 7 and Ics is=I2-I1.

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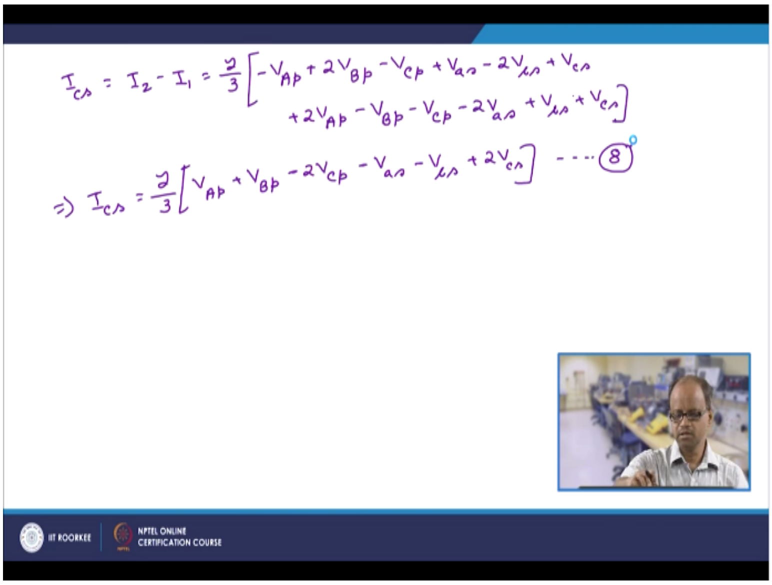

So Ics is=I2-I1 that is y/3-VAp+2VBp-VCp+Vas-2Vbs+Vcs so this is I2-I1 so it is +2VAp-VBp-VCp and -2Vas+Vbs+Vcs. So then therefore Ics is=y/3*VAp+VBp-2VCp then –Vas-Vbs+2Vcs. So this is equation 8. So now what we have got, we have got the 3 equations at the secondary side. Now we have to get the 3 equations at the primary side and then we have to write down the inter Y bus matrix right. So this we will do in the next lecture. Thank you.