Fundamentals of Electrical Engineering
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Lecture - 55
Single Phase Transformer (Contd.)

So, next we are back again, so let us take another example.

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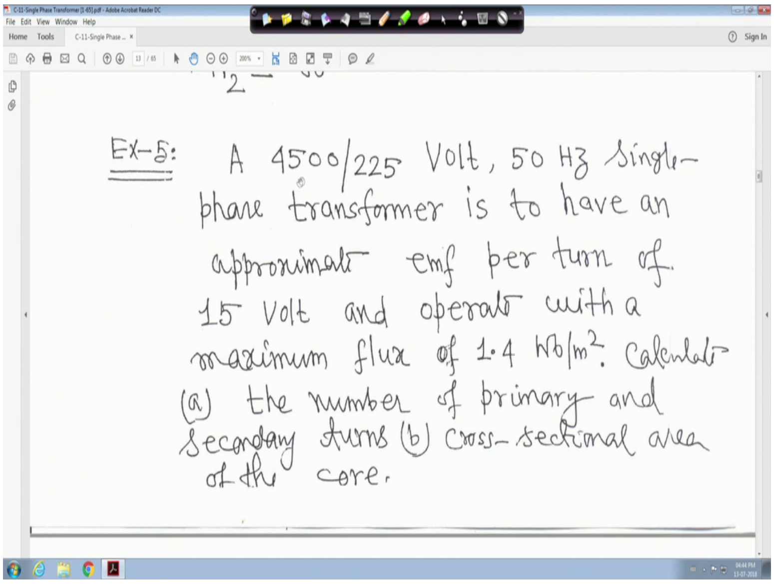

Say 4500 upon 225 voltage in a step down transformer 50 Hertz, 50 Hertz means the frequency, right f is equal to 50 Hertz. Single phase transformer is to have an approximate unit per turn of 15 volt that is given and operate with a maximum flux of 1.4 Weber per meter square. Calculate the number of primary and secondary turns, cross-sectional area of the core right, this two things we have to determine.

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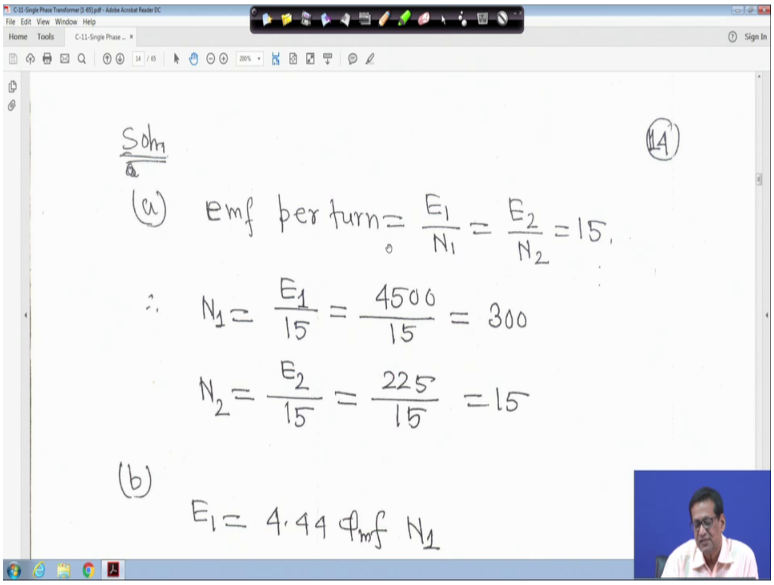

So, emf per turn is equal to E 1 upon N 1 is equal to E 2 by N 2 is equal to 15, it is given therefore, N 1 is equal to E 1 upon 15 that is also V 1 up on E 1. So, right is equal to E 2 upon N 2 is equal to 15 that way you can make it. So, it is given 4500 by 15. So, you will get it is 300 because it is primary side where 4500 volt. Similarly secondary side 225 Volt so; N 2 is equal to 225 by 15, so it is 15, right N 2 is 15.

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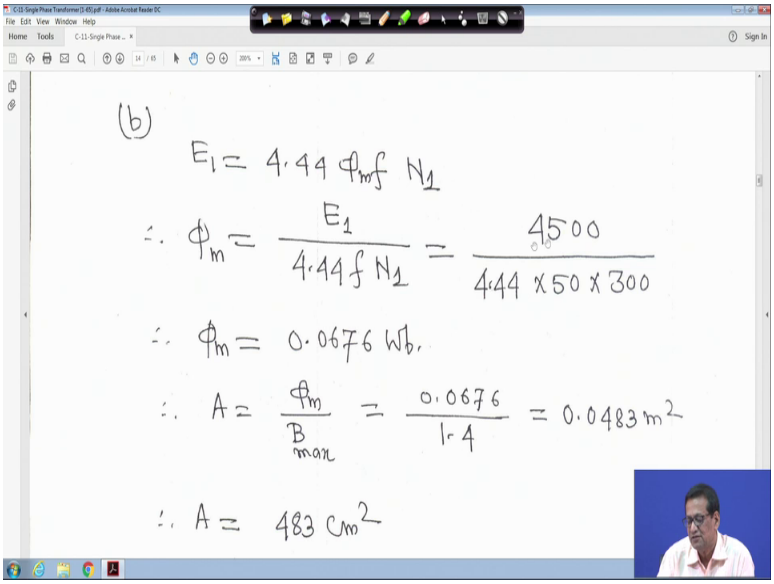

Now, we know E 1 is equal to 4.44 phi m f into N 1 therefore, phi m is equal to you just put E 1 value and all these values. So, E 1 is 4500, so we will get 0.0676 Weber.

So, A, we know phi m is equal to A into flux density, right. So, A is equal to phi m by B max. So, phi m is given maximum flux density 1.4 Weber per meter square is given. So, it is basically 0.0483 meter square therefore, 483 centimeter square, right.

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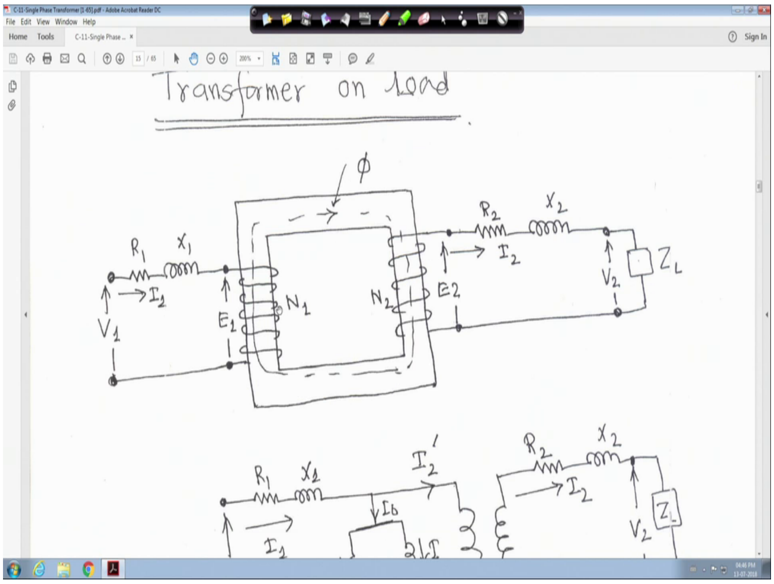

So, now next is a transformer on no load, right when transformer sorry transformer on load when transformer is on load, so first this transformer on load. So, first when you will go through this first to draw this circuit, right then will see. So, we if you draw this your what you call the circuit. So, this is your this is your primary side and this is your secondary side, a the load is connected, a load is connected.

Now, from our magnetic circuit loop this R 1 and X 1 these are the two your therefore, a resistance and reactance of the winding. These two resistance we put it here, right as we nothing is here. So, this is your what you call E 1, E 2 neglect all this E 2 neglect all this when E 1 is equal to it is the magnitude wise V 1 is equal to E 1. But when it is loaded at that time this is R 1 X 1. So, this is Volt as if it is a ideal transformer R 1 X 1 is here so this is V 1, is the this is E 1 and this is V 1 and arrow tips means its shows positive, right. And similarly here a load is there Z L is the load, right and this is also bullet voltage across the load is V 2 and this R 2 and X 2 it was secondary side that resistance and reactance.

So, in that case so earlier in for no load cases we have seen that you are what you call there was no current flowing in the secondary, right. And only prime only you are what you call that only primary side and alternating voltage are applied and this no load current yeah that is your what you call the current I 0 is very small that is called your exciting current it has two component, one is responsible for that your core losses another is for magnetizing component that is responsible for producing powers.

Now, in this case it is connected to the load. Now, before going to anything, so this is my N 1 turn and this is N 2 turn primary and secondary windings and this voltage is E 1 and this voltage is E 2, right. What you call E 1 and E 2 voltage basically you can say this is the ideal transformer in this voltage.

So, now if you apply your that you are what you call that your magnetic circuit you have started the, right hand rule suppose this is the direction of the current is taken. Let me clear it. So, this is the direction of the current is taken, right. So, if you grasp a conductor in the direction of the flow of the current you will see term is up. So, flux direction from this side will be phi, right.

So, as load is connected load is connected therefore, the current will be flowing like this. So, again if you wrap the you what you call conductor in the direction of the current you will find this one also will be this way. That means, effective flux will be getting reduced. So, in that case what is actually what is happening that emf produce by this one say by this one it is it is sorry not emf, mmf; mmf produced by this one will be N 1 I 1 and, right and this one will be N 2 I 2 actually it will be N 1 I 1 is equal to minus of N 2 I 2 it is something like this it is something like this. Suppose, let me clear it.

Suppose I have this transformer, I have that this is a transformer symbol I have the transformer say this is my current I 1, right. Let me clear it. Let me clear it let me make it a little better way just hold on, right just hold on.

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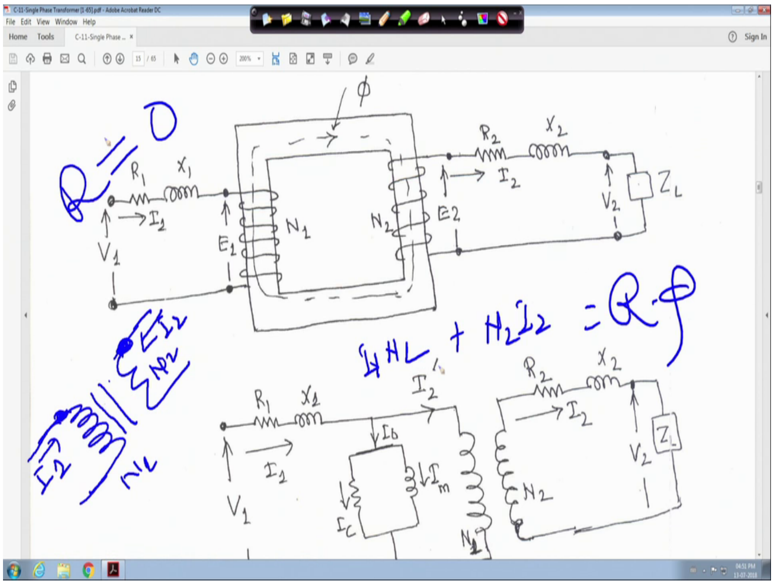

Suppose this is my, this is my transformer, right and current actually flowing here is say I 1 for example. And trans here it is N 1, and this is my secondary side, right primary secondary side and here also say current say this is I 1 turn this turn this is the N 2 and say current is here it is I 2. So, I am taking just entering. Put a dot here, put a dot here for an ideal transformer, so you will see mmf on this side your I 1 N 1 and this side plus N 2 I 2 is equal to the reactance into phi, right. The way we have done it that you are what you call both current are entering into that dot the magnetic circuit whatever you have studied, right. In other if you do so you will find this two are additive because you apply the your what you call, right hand rule according to this.

If you do so, but for an ideal transformer the reactance is look at the assumptions whatever made in force the reactance R is equal to your 0, right. If it is so that means, my N 1 your what you call I 1 N 1 plus I 2 N 2 is equal to 0, that means. Let me clear it.

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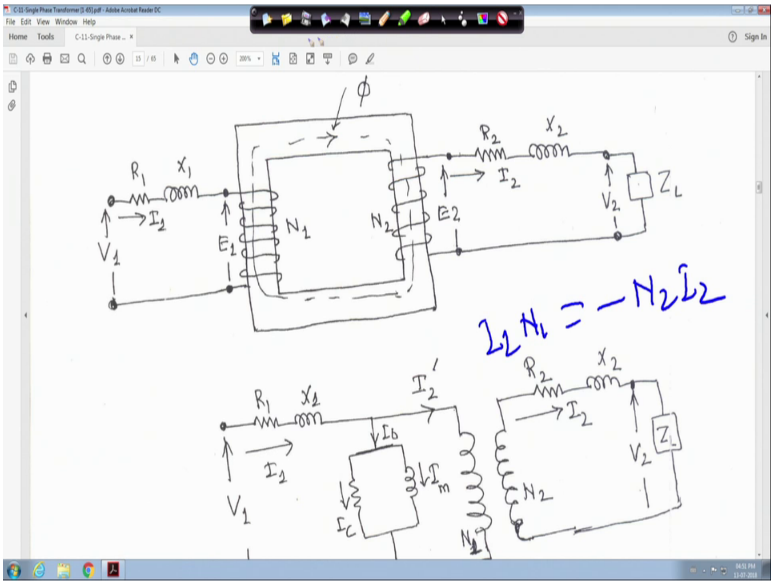

That means, my I 1 N 1 is equal to minus your N 2 I 2 that means, I 1 and I 2 there will be anti phase. N 1 N 2 the constant with it turns, right and I 1 and I 2 will be an anti phase. So, this is one way. Another, this is and another this one that is why that is why as it is minus.

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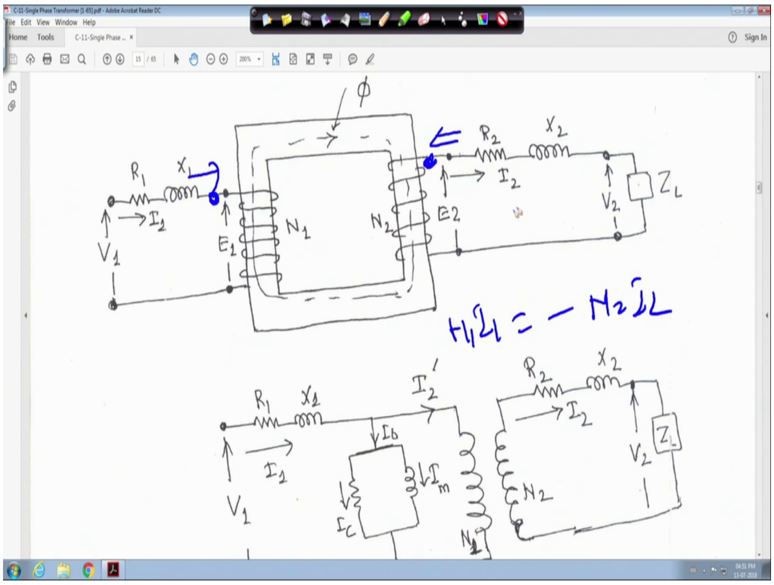

So, we have the, if you put a dot here, if you put a dot here, and if you put a dot here, right if you take the direction of the current like this and these. So, N 1 I 1, your is equal to your minus N 2 I 2 that means, there in anti phase, right that means, that is why the direction of the current is this way that is this going to the load. So, let me clear it, right. So, this is your what you call that why transformer is on load.

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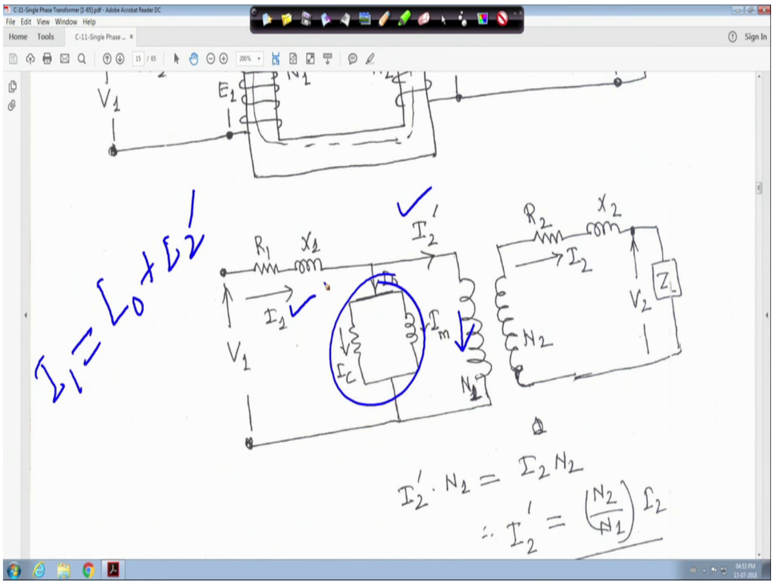

Therefore now this equivalent circuit actually we have seen that, right up is there later you can go through it, but whatever why told from my mouth just listen write up is there about this. So, the R 1 and X 1 is the primary side resistance and reactance and this is actually we are meant to this is your what you call that I c and I m that is your primary side we are giving the alternating supply.

So, this I c current you are what you call a core loss component is there so, it can be represented by an equivalent resistance, right. Similarly magnetize in current I m responsible for producing no load flux, right. So, it can be represented by your what you call; by an your what you call and in your in inductance. So, and this is the current I 0. So, this means these two in for these to a parallel circuits. So, it give you that I 0 is equal to I c minus j I m.

And this is the secondary side that R 2 and X 2 and this is the current flowing through the load this is that your that ferromagnetic material primary ending secondary so on and this is the load. And this is the voltage that was the load is V 2. Anybody aero it means instantaneous polarity plus and this is minus and this turn this is N 1 turn is an N 2 turns.

Now, I am clearing it now current from here from the source from the supply it is I 1, but part of the current that I 0 is going here I 0 is equal to your I c minus j I m. But yes the current is I 2 dash that means, I been figure some that I 1 is equal to your I 0 plus I 2 dash, right. So, in this case what will happen this is the current going through the primary winding. Earlier I saw I 1 I one because for ideal transfer all these things are neglected. Now, this current I 2 dash N 1 as per our this thing this is I 2 dash N 1 mmf this thing is equal to I 2 N 2. So, I 2 dash when you solve the numerical it will be N 2 upon N 1 I 2 this we will do.

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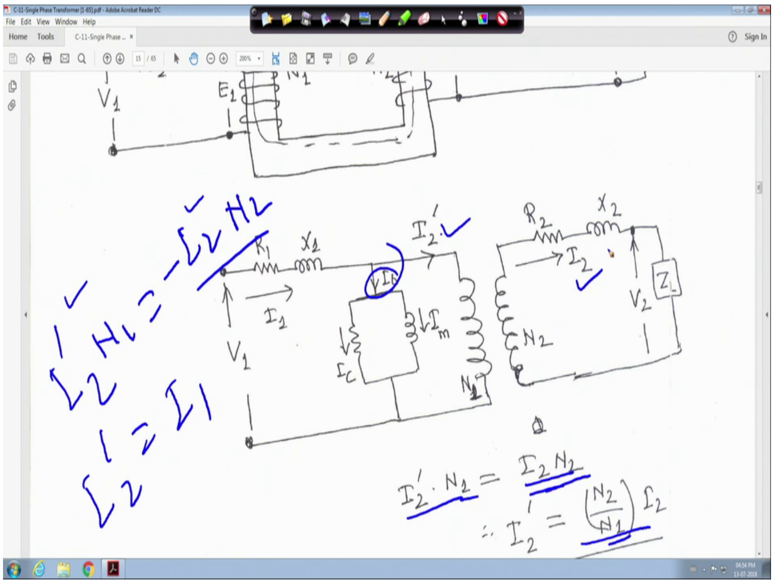

But in that our explanation whatever was there that is actually should have come I 2 N 1 is equal to minus I 2 N 2, right. So, just in anti phase that means, I 2 dash an I 2 actually in anti phase is this I 0 is neglected then I 2 dash is equal to your I 1 that is why I wrote N 1 I 1 is equal to and from an ideal transformer, right. So, that means, mmf this side primary side must be equal to mmf of the secondary side as the magnitude on this sign come, right and this sign also I also I told you. So that means, I when you will draw the phasor diagram then this I 2 dash and this I 2 will be in anti phase that is 180 degree difference of phase shift.

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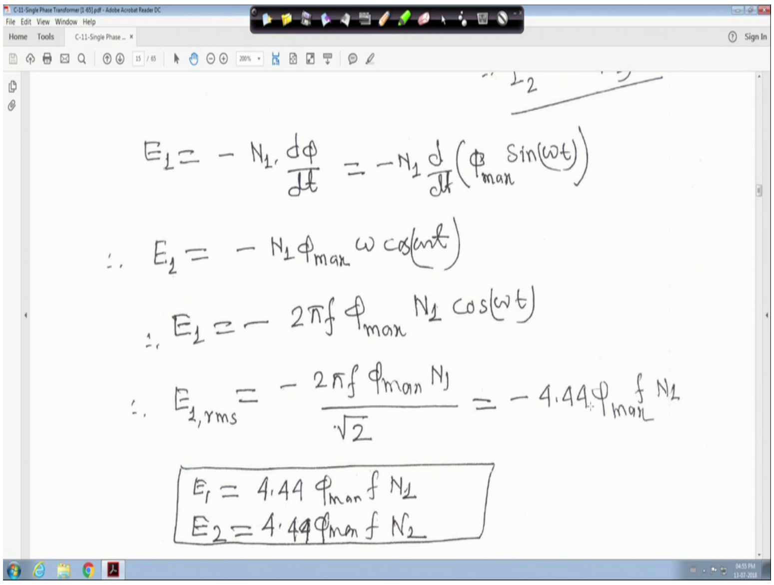

So, in this case we know that E 1 is equal to minus N 1 d phi by dt. So, you know E 1 is equal to this much, right this one already we have seen, already we have seen in magnetic circuit also we have solve one or two numerical. So, this is my E 1, in this is my E 2, earlier is this thing is given.

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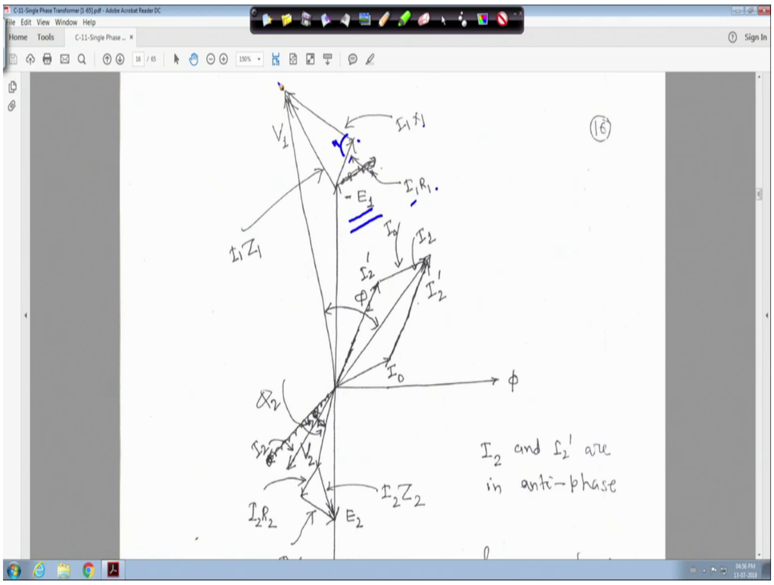

Now, now if you look at the phasor diagram let me let me reduce the zoom, right. So, if you see the phasor diagram first one or two things let me tell you, this is nothing. The way it was there I made it this will also nothing this will also nothing, right if it is cut.

So, in this case let me clear it in this case that V 1 and E 1 balance is lost because it is on it is on your what you call, it is on loaded, secondary side is loaded the and V 1 if you look into the circuit just first let me explain here. So, V 1 is equal to that is your minus E 1 then this one is I 1 R 1 and this one 90 degree with that this is 90 degree because it is reactance, so I 1 R 1, so this is my V 1, right. So, let me clear it. So, if you just hold on. So, if you look into the circuit, if you look into this circuit, right if you look into this circuit so yeah if we when you draw this your phasor diagram. So, V 1 will be when you are taking that V 1 earlier for ideal transformer V 1 is equal to minus E 1 but now this R are the loaded because of the transformer is loaded, secondary side is loaded. So, R 1 I 1, R 1 plus j I 1 X 1 turn (Refer Time: 12:18).

So, that is why V 1 is equal to minus E 1 plus your I 1 R 1 plus j your I 1 X 1, that is why this phasor diagram your what you call this phasor diagram is V 1 is equal to your minus E 1 I 1 R 1 plus your j I 1 X 1 this is the this one.

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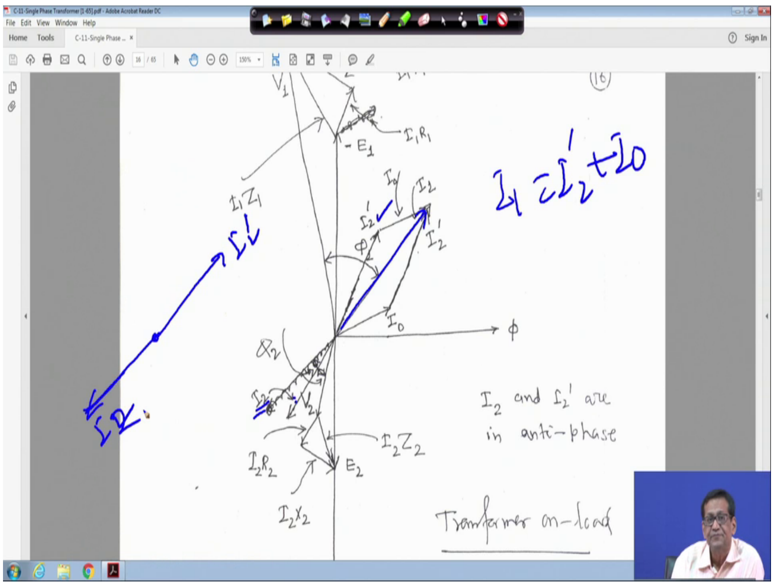

And second thing is that if you look into this if you look into this that your I 1 I 1 is equal to I 2 dash plus I 0 when you will make it you see the circuit diagram. Now, this is my I 0 that your no load current and this is my I 2 dash and this is your I 1, right. But I 2 dash and I 2 the secondary current must been anti phase. So, that is why this one is I 2 that is written here this is I 2 actually the slightly it is if this thing. Suppose if it is there if this is my if this is my I 2 dash then your what you call then this one this one will be my I 2 they will be in anti phase, right because of that convention.

So, that is why this is my I 2 dash and this is I 2, I 2 is drawn here this phasor is I 2, this phasor is I 2. So, let me clear it. Therefore, in the secondary side so E 2 will is equal to if you look, E 2 will be is equal to V 2 plus I 2 R 2 plus j I 2 it. If you apply we just let me clear it if you apply K v l in the circuit if you apply K v l in this circuit, right.

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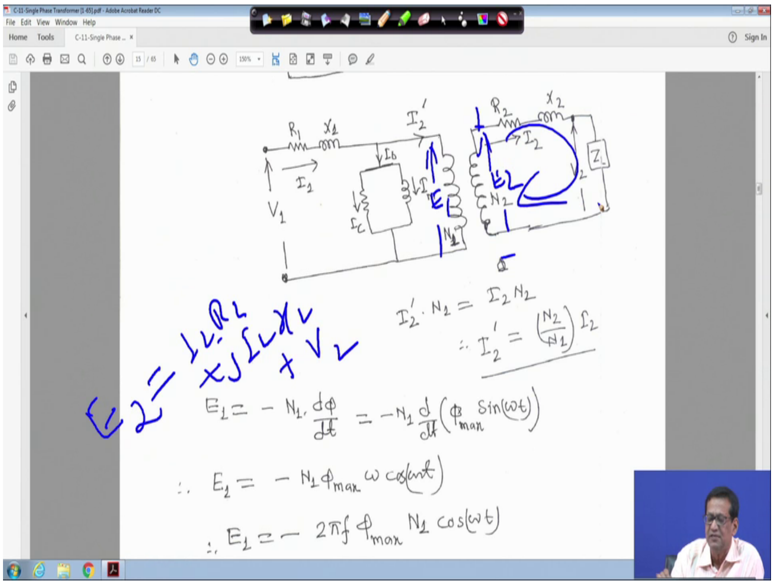

So, this is your E 2 this is your E 2, right in this circuit also this is my E 1 this is your E 2 and this is plus minus, right. So, if you your what you call if you apply K v l then you are E 2 will be is equal to, right this is your I 2 R 2 plus j I 2 your X 2 and plus your V 2, right. So, that is your, E 2 is equal to V 2 plus I 2 R 2 plus j I 2 X 2. So, you just apply K v l, just apply K v l here, right.

So, that means, this one that is E 2 is equal to V 2 plus I 2 R 2 and this I 2 X 2 these angle this angle will be 90 degree, right this angle will be 90 degree. And resultant will be this voltage drop will be I 2 into Z 2 similarly here also this part will be I 2 I 1 into Z 1. And this current I 1 current I told you it will be I 0 phasor sum plus I 2 dash, right and angle between V 1 and I 1 will be say this angle is phi 1, right. And similarly angle between I 2 and V 2 this angle is equal to phi 2 it is shown here it is phi 2, right only thing is that this portion is nothing this portion is nothing but, similarly this portion is nothing, right.

So, I hope you are I 2 and I 2 dash are in anti phase. So, I hope that and this is the same as before the flux phi is your reference phasor, right. So, this is this phasor diagram the transfer on no load. I hope you have understood this say your what you call this just hold on this phasor diagram. So, there is that should not be any confusion any confusion, right.

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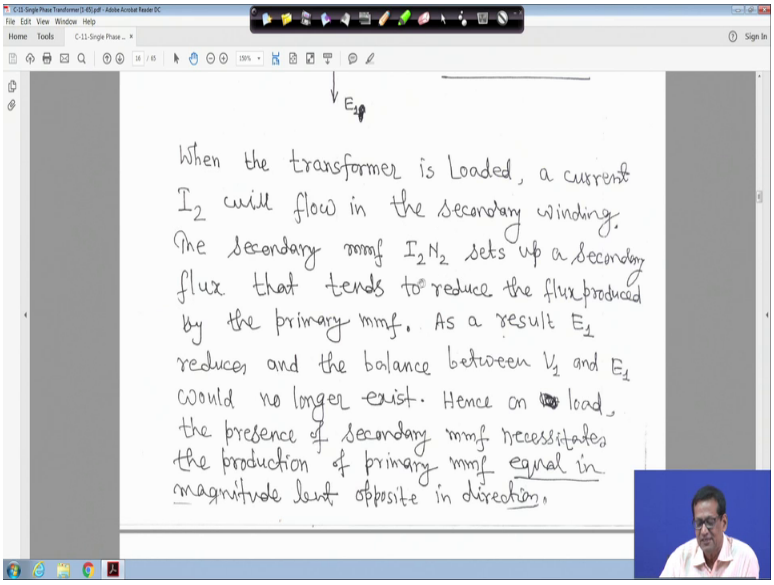

When that now there write up is there is just when the whatever I said when the transformer is loaded a current I 2 will flow in the secondary winding. The secondary mmf I 2 N 2 sets of a secondary flux that tends to reduce the flux produce by the primary mmf. That means, this is actually primary mmf whatever it was I 2 dash into N 1 and this is secondary mmf I 2 into N 2.

And you use that what you call use that, right hand rule and then you will see the direction of the flux and then you will see so it will try to reduce that effective flux, right. That is what has been written here you apply the, right hand rule from a magnetic circuit, you grab the conductor in the direction of the flow of the current and your term will be the direction of the flux, right.

So, your I 2 N 2 sets of a secondary flux that tends to reduce the flux produced by the primary mmf. As a result E 1 reduces and the balance between V 1 and E 1 would not would no longer exist, right. Hence on load the presence of secondary mmf actually a necessitates the production of primary mmf equal in magnitude, but opposite in direction that is your N 1 I 2 that is equal to minus your what you call N 2 I 2, if your I 0 is neglected then I 2 dash is equal to I 1.

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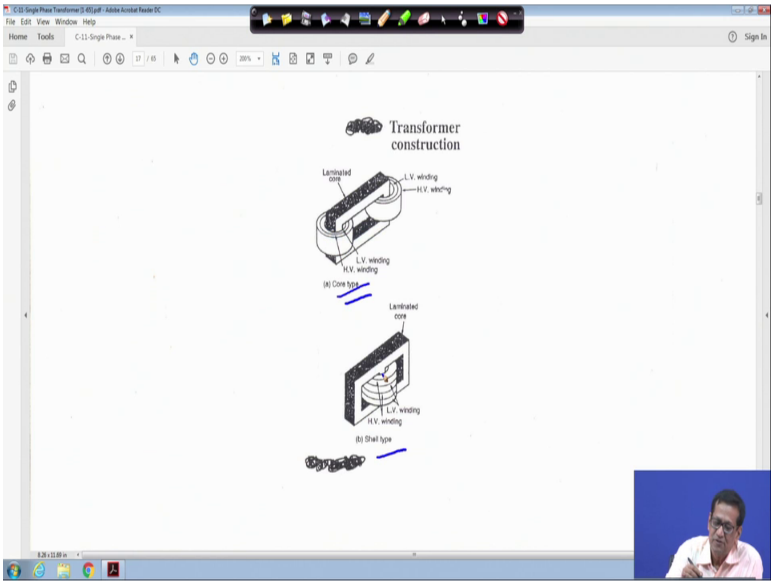

Next is the little bit of construction of the transformer. So, this is I have taken from a book, right. So, generally that whatever we solved the numericals and other thing that is but very equivalent circuit. But if you look into that that lower that is this is core this is core type transformer that low voltage winding an above that your high voltage winding how they are there and this is laminated core. That is your real that is your practical transformer.

And if the shell type transformer is there if you look into that you will find low voltage winding and high voltage winding, then low voltage winding and high voltage winding, right. So, these are the two type different two different type of construction. Only one thing one thing I will tell you that you read any book and see the differences between the core type and your shell type what is the main different, right. This you should go out appear on here, I am skipping it that thing, right.

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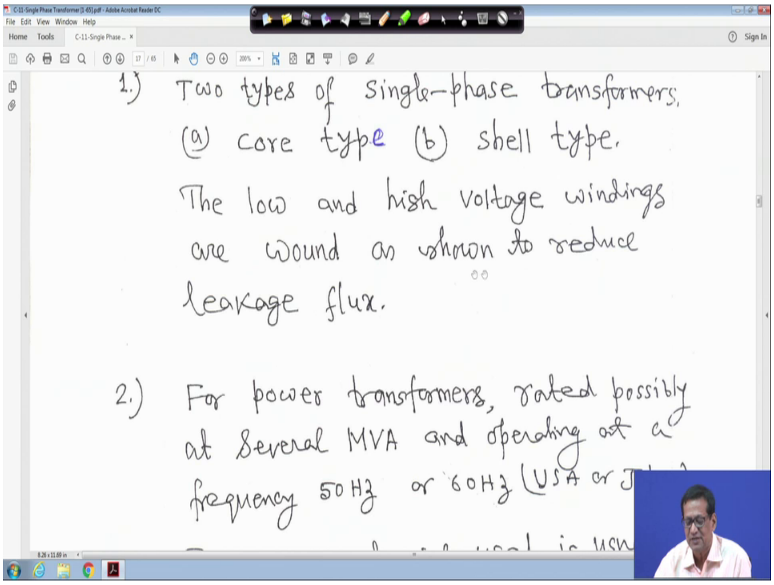

So, in this case this kind of construction is made because it is core type and shell type the low and high voltage windings are wound as shown in reduce the leakage flux, right.

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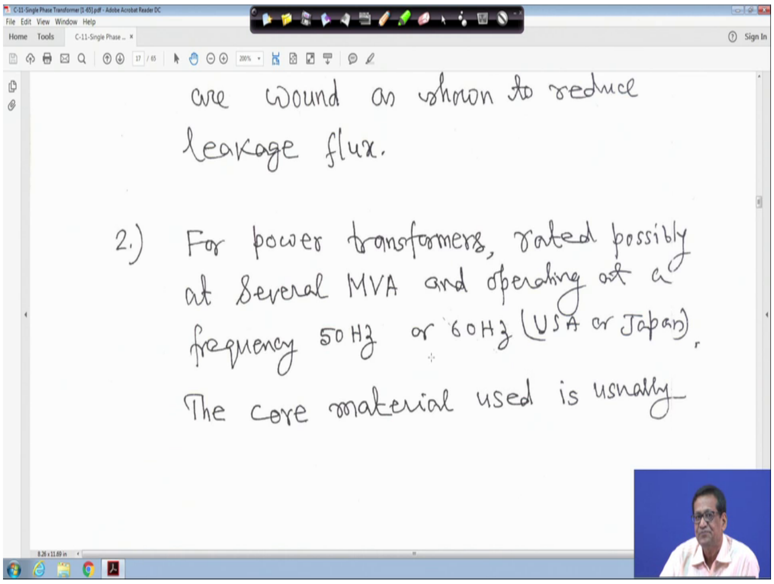

And similarly for power transformer rated possibly at several MVA and operating at a frequency 50 Hertz or 60 Hertz that is USA actually it is 60 Hertz and 50 Hertz or 60 Hertz both are there in Japan, right.

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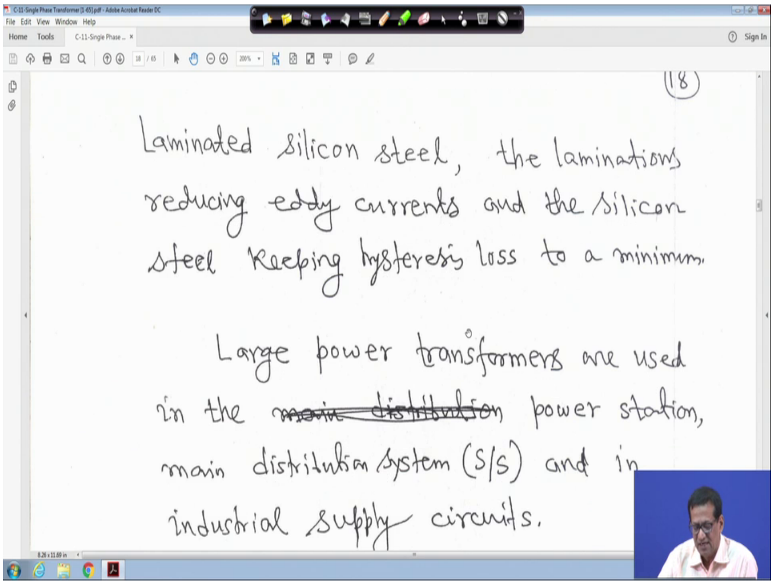

The core material used is usually your laminated silicon steel. The laminations reducing actually eddy current that is why laminated and the silicon steel keeping hysteresis loss to a minimum, right.

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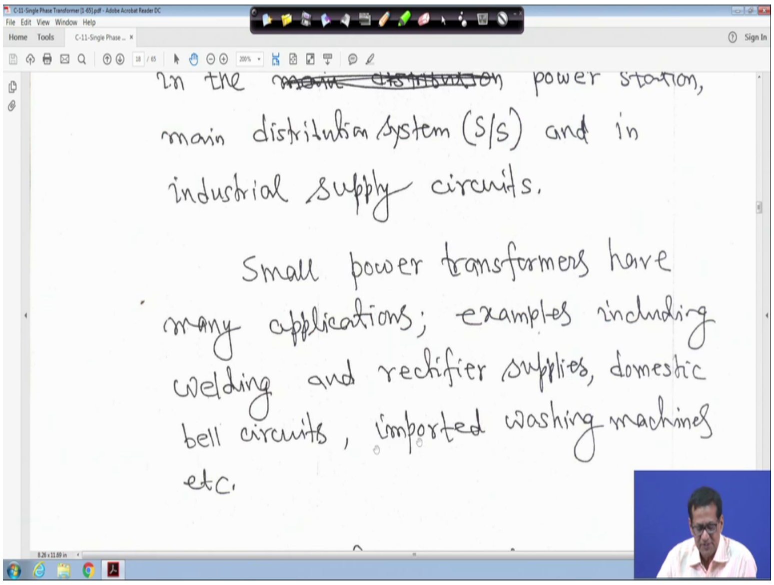

And large power transformers are used in the power station main distribution system and in industrial supply circuit, right.

So, small power transformer have many applications. Example, including welding and rectifier supplies then domestic bell circuit imported washing machine it is I mean so many things are there for small power transformer.

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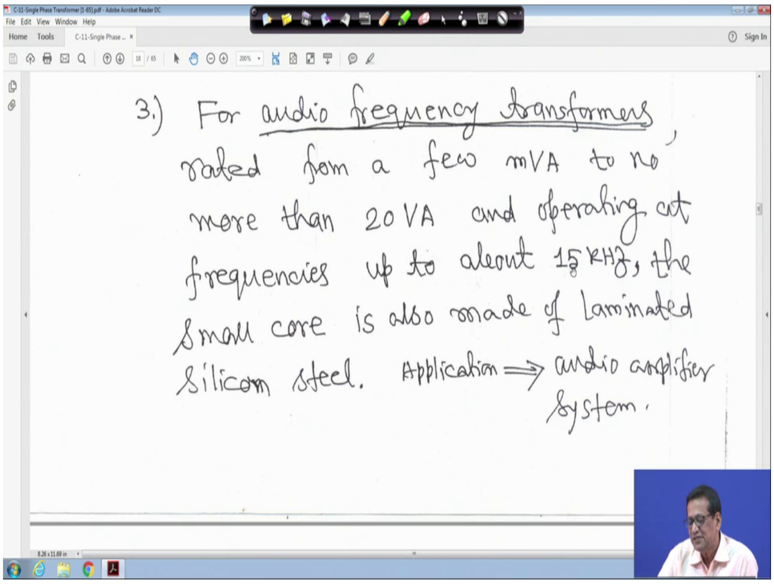

Now, then another thing this will not cover just for general knowledge. For audio frequency transformers rated from a few milli Volt ampere to not more than your 20 Volt ampere, and operating at frequencies up to your about 15 kiloHertz the small core is also made of laminated silicon steel application audio amplifier system. This is just for purpose of general knowledge will not study that.

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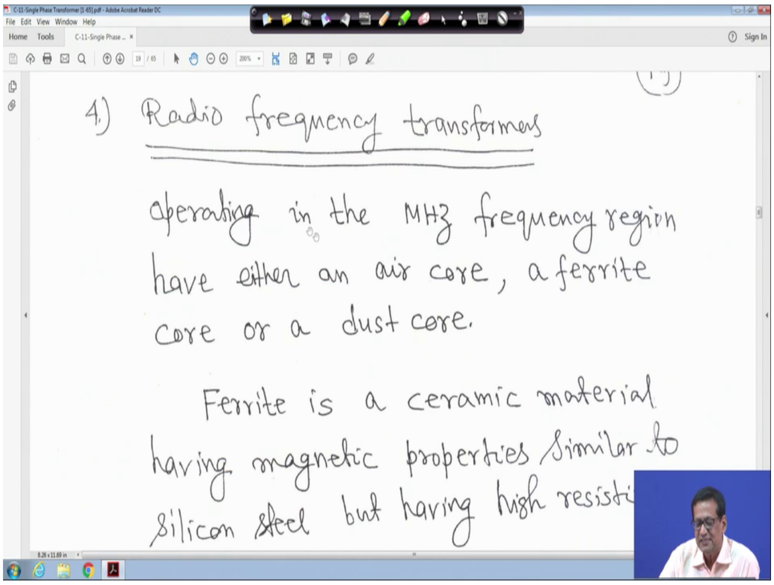

Radio frequency transformer it is operating in the megaHertz frequency region, have either and air core a ferrite core or a dust core.

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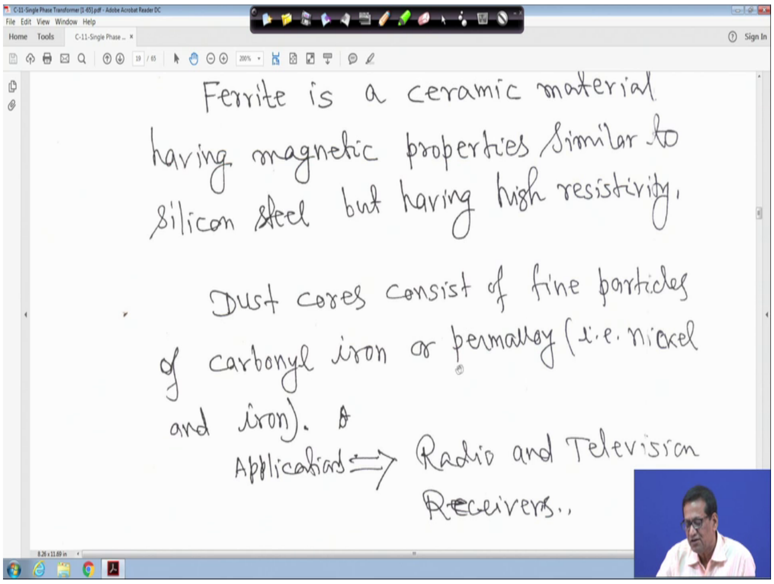

So, ferrite is a ceramic material having magnetic properties similar to silicon steel, but having high resistivity. Dust core consists of fine particles of carbonyl iron or your call permalloy that is your nickel and iron application radio and television receivers, right.

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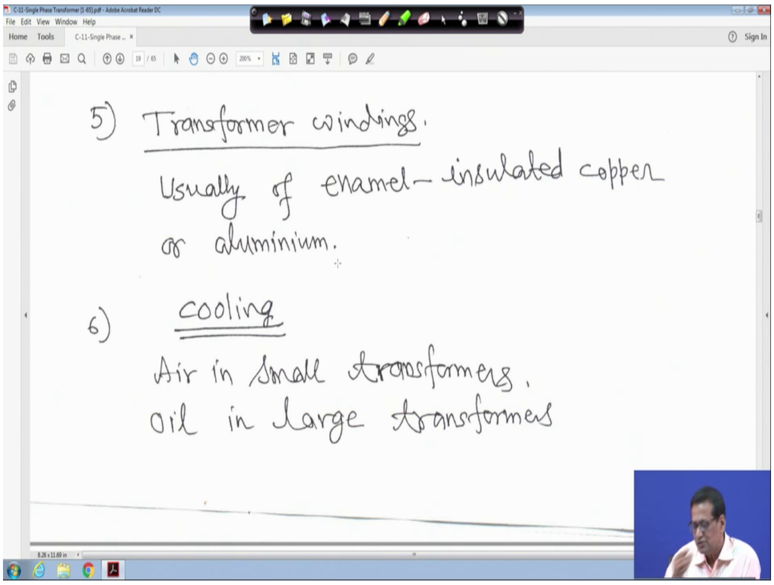

Now, next this transformer winding usually of enamel insulated copper or aluminium. If you; when you go through this in your college first year lab you can see that your windings of the transformer you open transformer, right. And cooling in brief air in small transformers and oil in large transformers, right cooling is a huge chapter, right in a electrical engineering for transformers so just to give you some general ideas.

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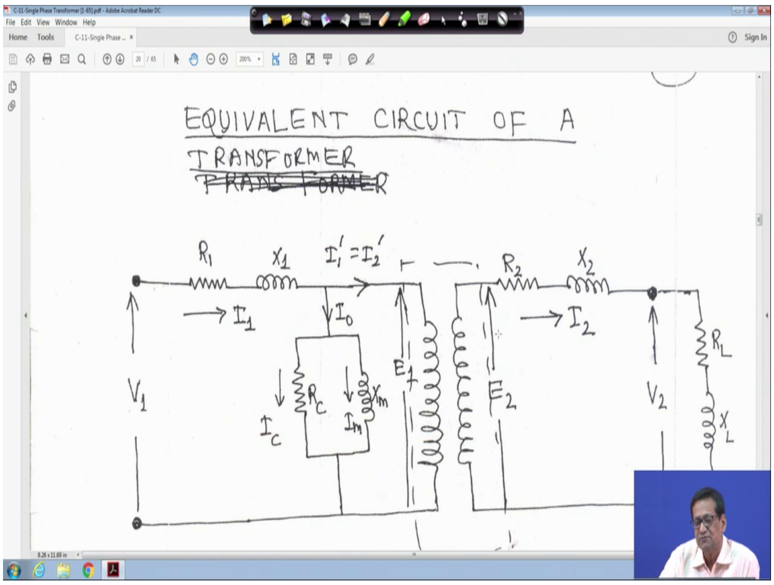

Now, equivalent circuit of a transformer because we have seen transformer, but we have to obtain the equivalent circuit of transformer because you have to solve problem how to solve the problem for an equivalent transformer or a equivalent transformer. For that we need to know the equivalent circuit of a transformer, right.

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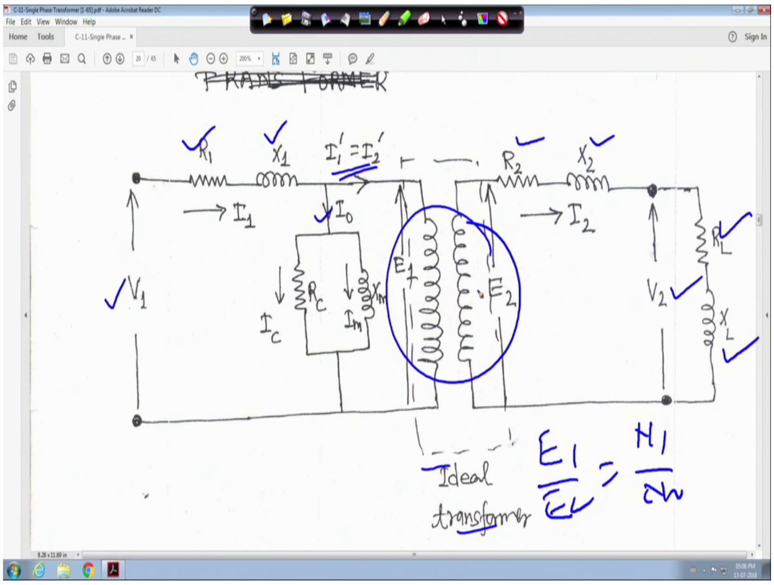

So, generally what happened that whenever look at that whenever a transformer your what you call is loaded, so load means say it load means say inductive load. So, suppose it resistance that you load resistance is R L and say reactance is X L j is not put any have, but when you solve the problem you have to put j the complex operator and voltage across the load is V 2 it is given here, right.

And this is R 1 X 1 the primary side resistance V 1 is the supply voltage, and current through this is I 0 that is your may your what you call that is your no load current and this current I 1, I 1 is equal to I 0 plus I 2 dash that is phasor, right. And this current your this side we can call it is I 1 dash is equal to I 2 dash we can call also this is I 1 dash is equal to. So, I 2 dash, right.

So, and this is also R 2 X 2 that means, this winding as it nothing is there, there ideal transformer. So, this portions call ideal transformers, right. So that means, in this case your E 1 by E 2 is equal to N 1 by N 2 is an ideal transformer as if everything is taken out from the transformer are represented by two winding. So, this is E 1 E 2. So, this at this portion that is why by dash line in this portion is shown by ideal transformer, right and current flowing through this load is I 2 and this current is I 1 and this is I 2 dash.

So, now, what we have to do is we have to make an equivalent circuit either it will bring either you bring all this parameters all this parameters to the primary side this is one way or you bring all these parameters to the secondary side either of this. So, who will take the secondary parameter to the primary side? So, how you will do it? So, then this is an ideal transformer the way we have represented everything as it this E 1 E 2 this is an ideal transformer that is written here, right.

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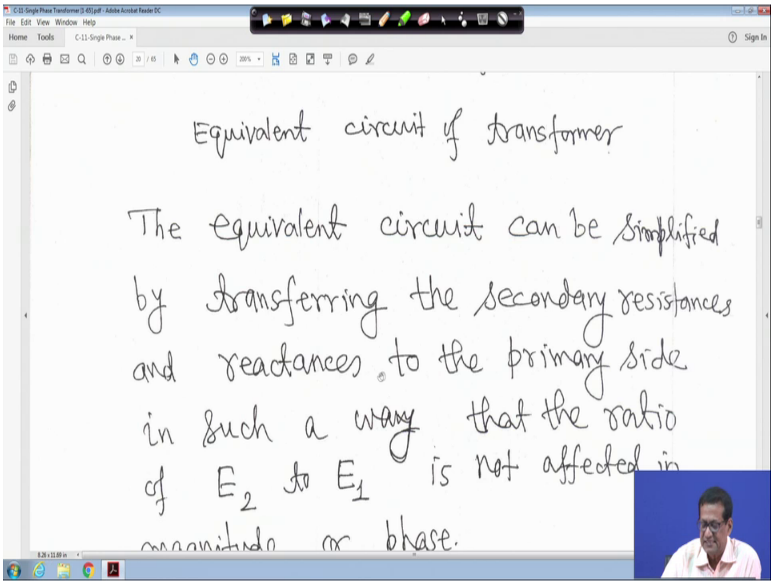

So, equivalent circuit of a transformer that is we have to this is this one we lot solve the problem we have to bring everything to one side that is say primary side.

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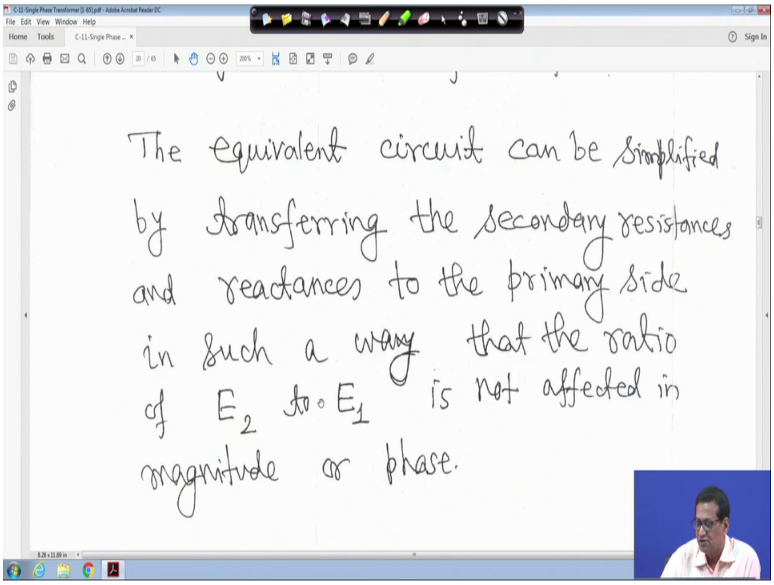

Now, the equivalent circuit can be simplified by transferring the secondary resistance and reactance is to the primary side in such a way that the ratio of E 2 to E 1 is not affected to magnitude or phase. That means, this one as if it is an ideal transformer. So, E 1 E 2 this is show you will never be affected not R 2 X 2 as well as this load also will transform to the primary side.

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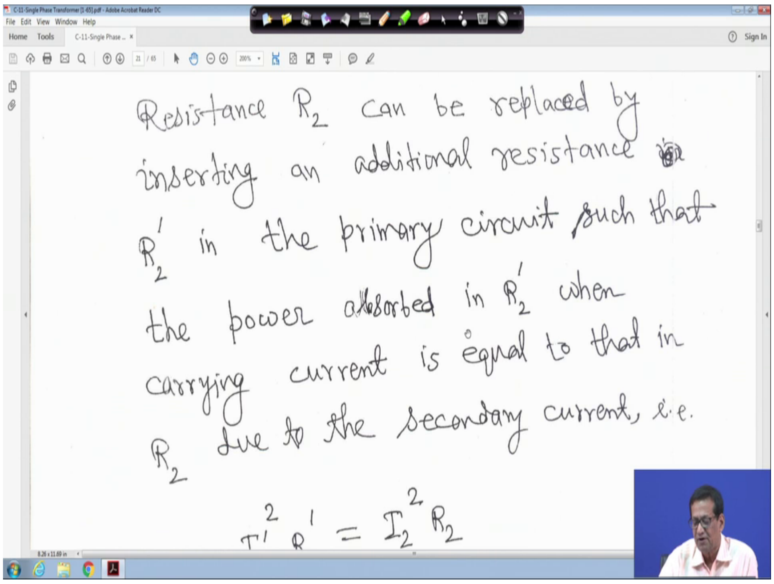

Now, if you do so, if you do so, resistance R 2 can be replaced by inserting an additional resistance R 2 dash in the primary circuit such that the power absorbed in R 2 dash when carrying current your is equal to that in R 2 due to the secondary current, right.

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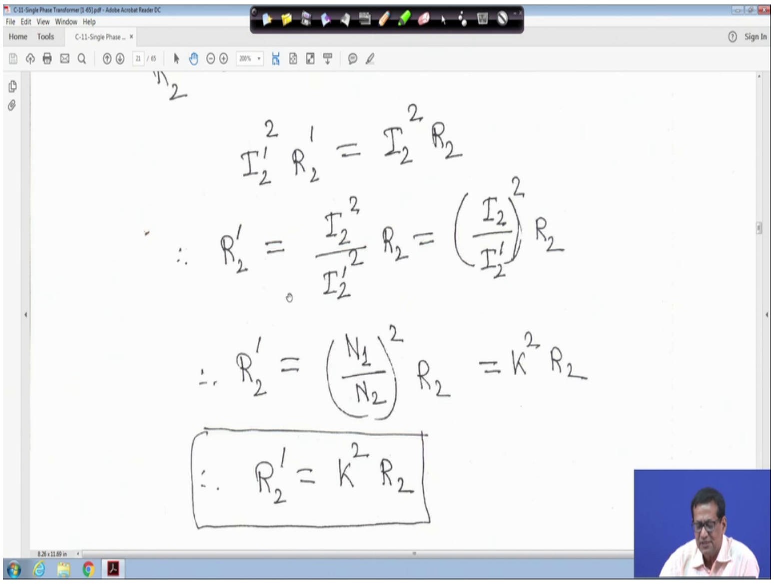

For example, for example, say take this circuit.

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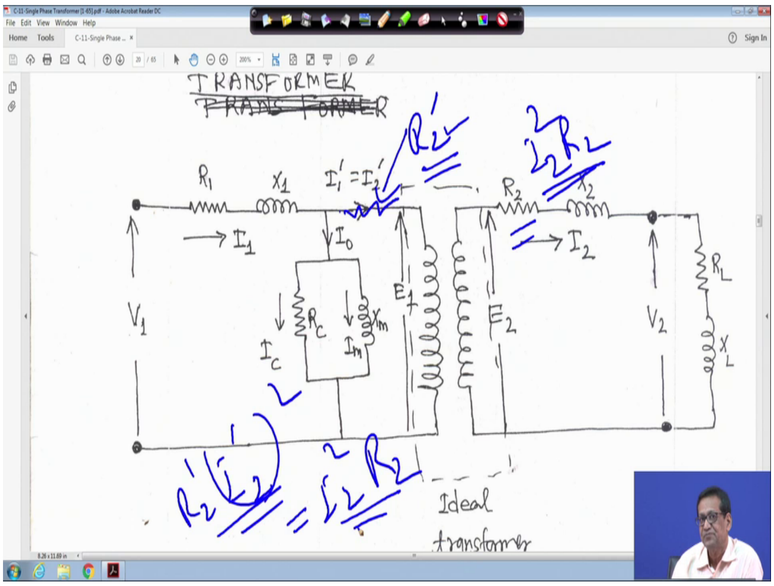

For example, I want to bring this one this side this side my power glass will be the current magnitude this is I 2 square is the magnitude in to R 2 to this is a power glass, right. Now, if I want to put that equivalent resistance similar to that on this supply your what you call on the primary side in suppose I have a resistance here. And suppose this value is R 2 dash, right. Therefore, this side loss actually it will be R 2 dash there your I 2 dash square, right.

So, these loss and this I 2 square R 2 loss both has to be your equal both has to be equal such that I will get the value of equivalent up to that, such that your what you call that your E 1 by E 2 ratio everything will remain same only thing is that, we have to insert one resistance we have to find on equivalent is R 2 dash, right whereas the loss of this one R 2 dash into I 2 dash square is equal to I 2 square R 2 this has to be same based on that only we transfer, right. So, if it is so, then in this case in this case I 2 dash square into R 2 dash is equal to I 2 square R 2, right that is R 2 dash is equal to my I 2 square up on I 2 dash square into R 2 that is I 2 upon I 2 dash your what you call square into R 2.

Now, from this and now I 2 upon I 2 dash is equal to N 1 upon N 2 because from this diagram your this, this one this trans for this one this trans ratio is N 1 and this trans ratio is N 2, right.

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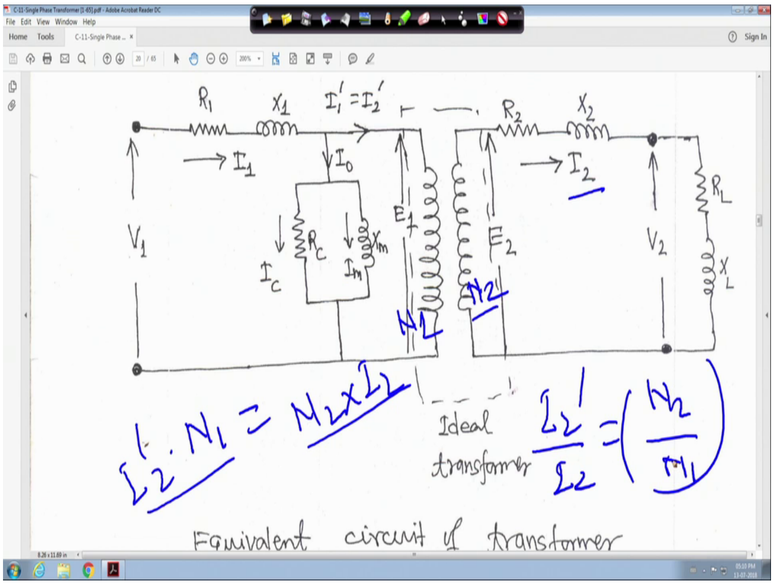

And current here is I 2 dash therefore, you can make it I 2 dash into N 1 that is mmf of the primary side is equal to mmf of the secondary side that is N 2 into your N 2 into your I 2, right. So, this is I 2 and at this N 2. So, N 2 I 2 is equal to how to I 2 dash N 1, right.

That means, I 2 dash upon I 2 is equal to N 2 upon N 1, right or I 2 upon I 2 dash is equal to N 1 upon N 2, right. So, that is what has been written here so that means, here you substitute that I 2 upon I 2 dash is equal to N 1 upon N 2 therefore, N 1 upon N 2 square into your R 2.

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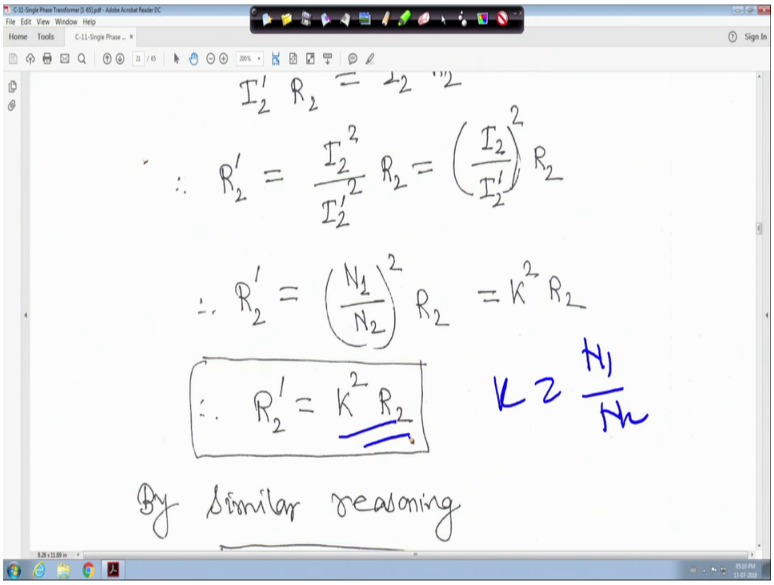

But we have seen earlier that K is equal to we have seen earlier the K trans ratio is equal to N 1 upon N 2 therefore, R 2 dash will be K square into R 2, right.

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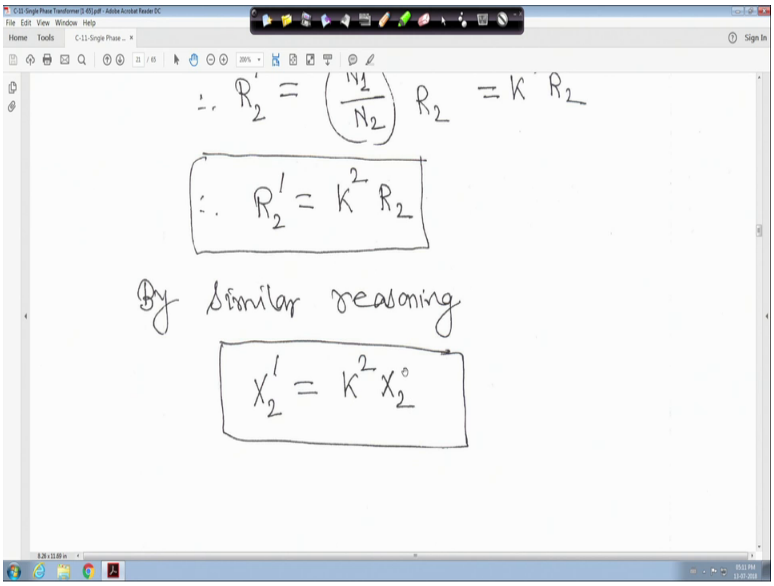

By similar way that reactance also can be transferred to that, so X 2 dash also will be K square into X 2, right.

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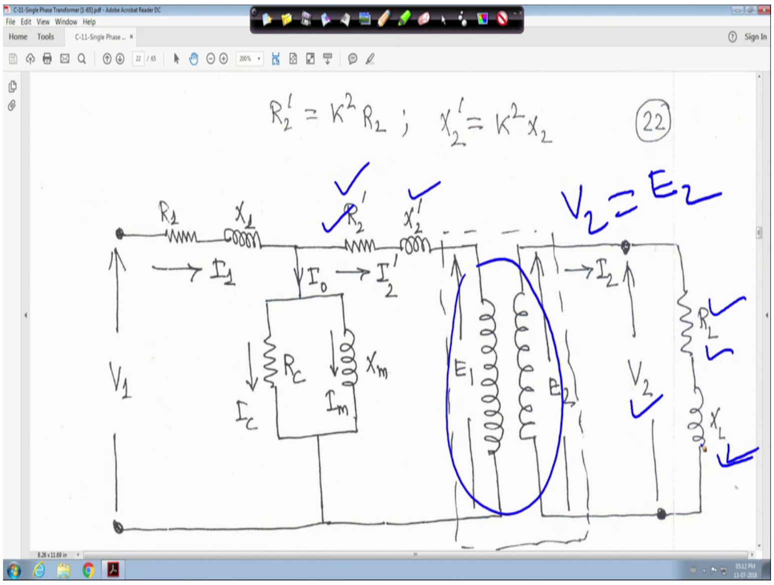

So, if it is so, therefore, R 2 dash is equal to L square R 2 and X 2 dash is equal to K square X 2. So, now this side your what you call the secondary side a resistance and reactance the equivalent one transferred to the primary side, right. but this is an your what you call, but this is an ideal transformer but load R L, X L is there V 2 is also there.

So, in that case what will happen at all this thing transferred to here. So, your primary or your secondary side my V 2 now is equal to E 2, right my V 2 is equal V 2 is equal to E 2, right. So, V 2 is V 2 is equal to your E 2 therefore, your because all this thing transfer here V 2 is the voltage across R L and X L to what one can your do is a primary side or equivalent one then what will be the equivalent voltage of your this V 2 to the primary side it will be nothing, but you are what you call that K into your V 2 will come to the primary side.

So, in that case and this R L and X L in similar way you can bring it to the primary side. R L also you can make R L dash X L will be X L dash that also can be transferred to the primary side, right.

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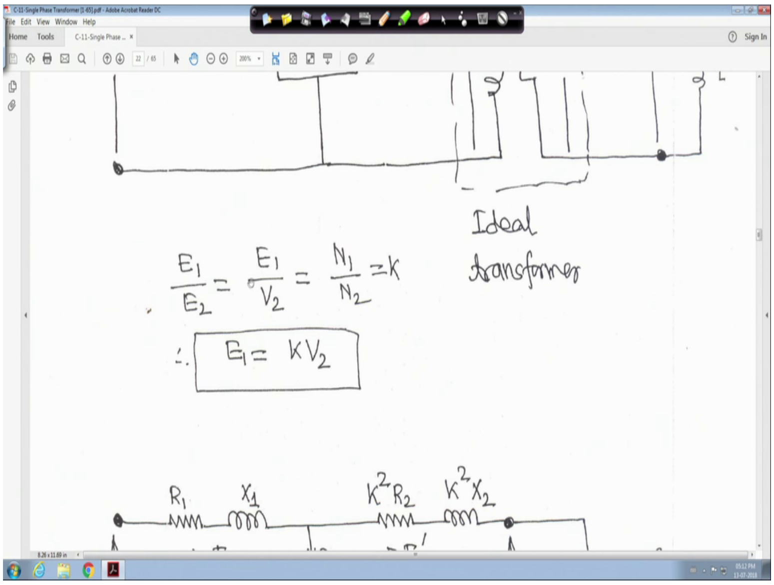

If it is so, similar way if it is so, then if you look into this that E 1 by E 2 is equal to you know N 1 by N 2 and E 2 is equal to V 2. So, E 1 by V 2 is equal to your K therefore, E 1 is equal to K into V 2.

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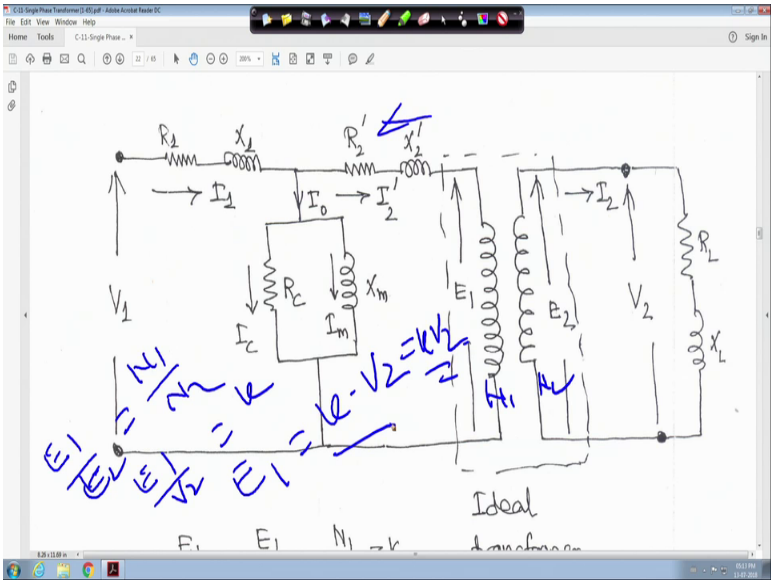

That means this side that means, this side voltage transformation it will be K into V 2 because it is ideal transfer this trans ratio is N 1 this is N 2 E 1 upon E 2 is equal to N 1 upon N 2 that is your E 1 upon E 2 is equal to your N 1 upon N 2, right. But E 2 is equal to V 2 because this thing is transformed to this side, right E 2 is equal to V 2 that means, your 1 upon V 2 is equal to K, right N 1 upon N 2 is equal to K therefore, E 1 is equal to K into V 2, right. And let me clear it.

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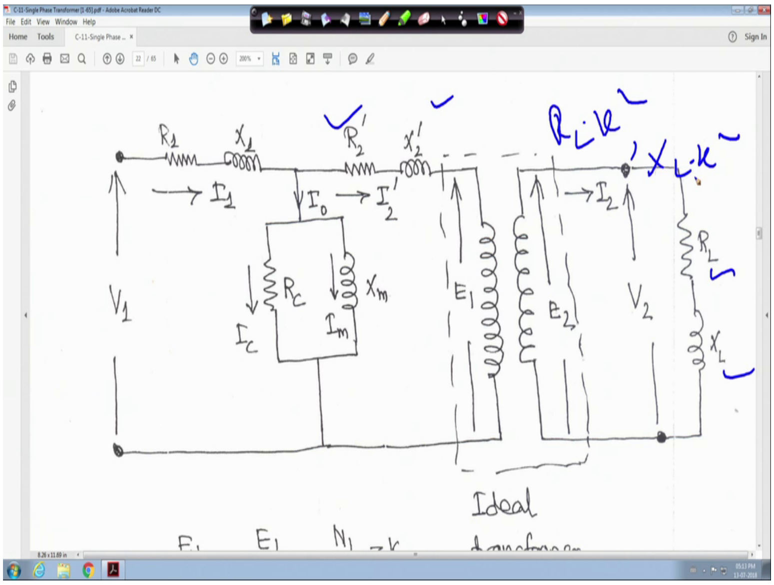

And when you transform this R L and X L to this side it will be then your R L into your K square. Similarly, it will be X L into K square the way you have transformed this, that is you R L dash and that will your X L dash. So, let me clear it.

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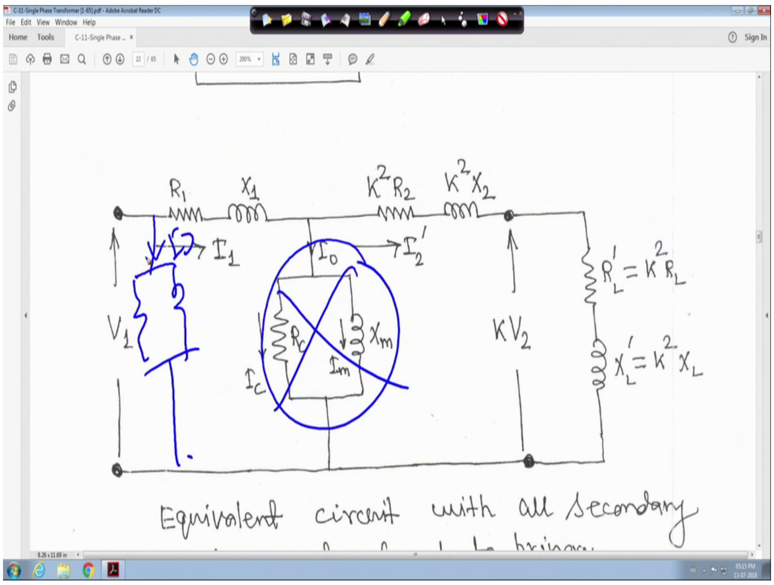

So, in this case your this R L dash is equal to K square your R L and X L dash is equal to K square into X L. I told you and your E 1 can be represent by K V 2. This is your E 1 it can be represent by K V 2 voltage across the load. So, this is actually equivalent circuit of the transformer, then what we did? We transform all the secondary parameters to the primary side, right and this is my V 1, this is my this one my primary is your what you call the parasite parameter this one also primary side parameters. And secondary side you have transform by multiplying your what you call just square of the trans ratio or transformation ratio that is K square R 2, K square X 2 and this is K square all that means, all the parameters resistance and reactance you have to multiply by K square and this should be K V 2.

So, this from the numerical point of view this you have to keep it in mind. But question is that this I 0 current actually this I 0 current is very small compared to the full load current, right. Generally your 3 to 5 percent, right. So, if you make this kind of series parallel circuit it will be not easy it will take time for your, what you call for solving numerical for computation. So, in that case what we will do what we will do this branch actually without your loosing much accuracy this branch will put somewhere here we will put somewhere here, right we will put somewhere here and this branch will remove from here and this will be my I 0. So, error will be very less, right for easy computation.

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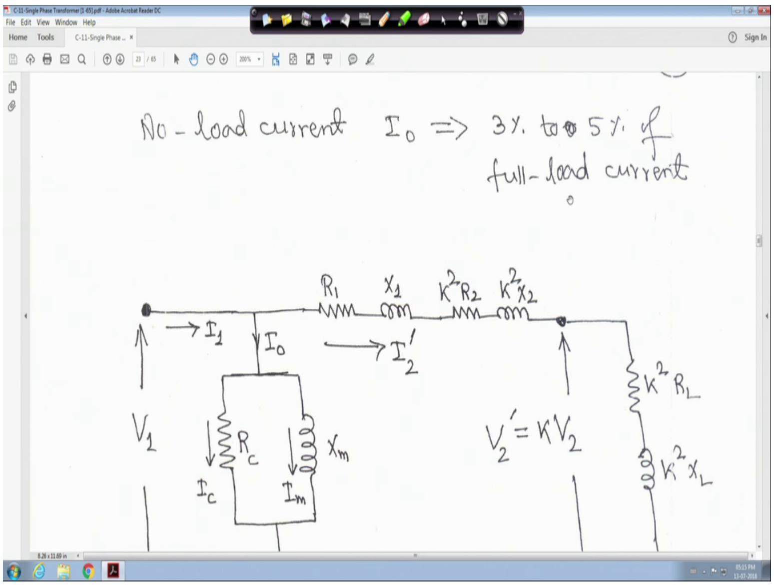

If we do so then this circuit that your I 0 is 3 to 5 percent of the full load current where circuits looks like this. So that means, you brought that one that means, of the beginning this is my I 1 and this is I 0 is going in that case I 1 is equal to your I 0 plus I 2 dash, right. So, R 1 and this is the total resistance R 1 plus K square R 2 the total resistance load we are not considering the load keep it separate then X 1 plus K square is very primary and secondary equivalent resistance, right, so Re is equal to Re 1 rather is equal to R 1 plus K square R 2 Xe 1 is equal to X 1 plus K of K square X 2, right.

So, this is an approximate equivalent circuit and this side voltage will be V 2 that is equal to say K into V 2, right and this is the supply voltage.

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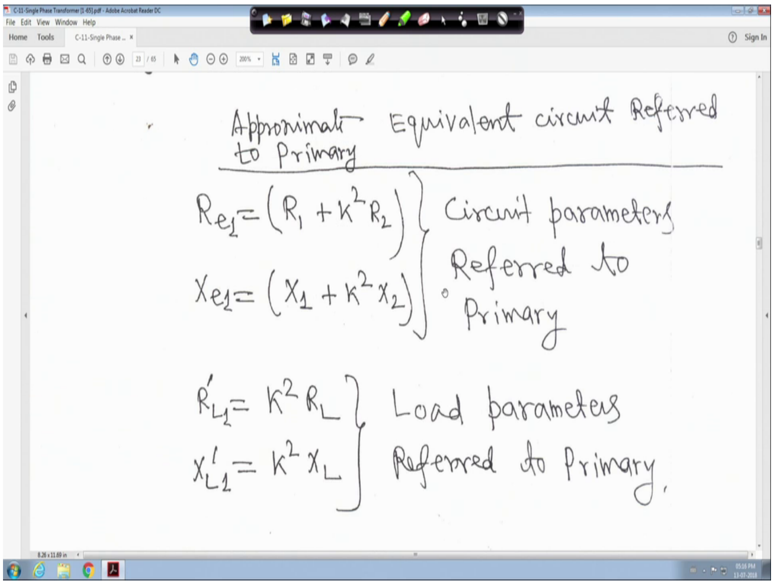

So, if it is so, then this is approximate equivalent your circuit referred to primary, right Re 1 is this one Xe 1 is this one. Thisvalue called referred to the primary side because everything we have brought it to the primary side, right.

And similarly R L 1 dash is equal to K square R L and X L 1 dash is equal to K square your X L that is the load parameters referred to primary. If you bring that other things suppose I want to take it to the secondary side the primary parameters that many things will change including your rp xm everything. So, in that case you should have been R 2 plus R 1 upon K square it should have been X 2 plus your X 1 upon K square. Similarly you should have been your R L upon K square and you should have been X L upon K square if it is refer to the your secondary side, similarly voltage also would have been changed, right you should have been you are divided by K instead of multiplication of K, right. So, what I will solve the numericals.

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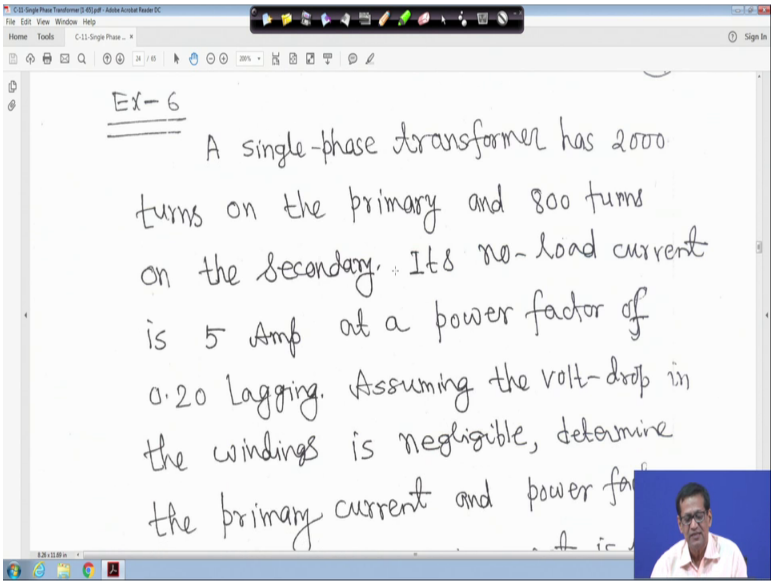

So, take a one small take a simple example. A single phase transformer has 2000 turns on the primary and 800 turns on the secondary side. Its no load current is 5 ampere at a power factor of 0.2 lagging, right because a no load power factor is very poor. So, assuming the Volt drop in the windings is negligible.

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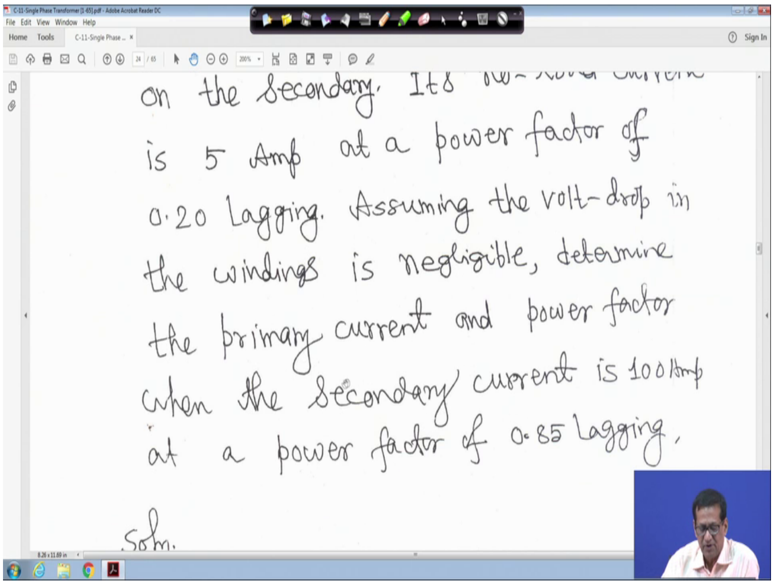

So, neglecting the drop determine the primary current and power factor when the secondary current is 100 ampere at a power factor of 0.85 lagging, right. So, this is the problem, right.

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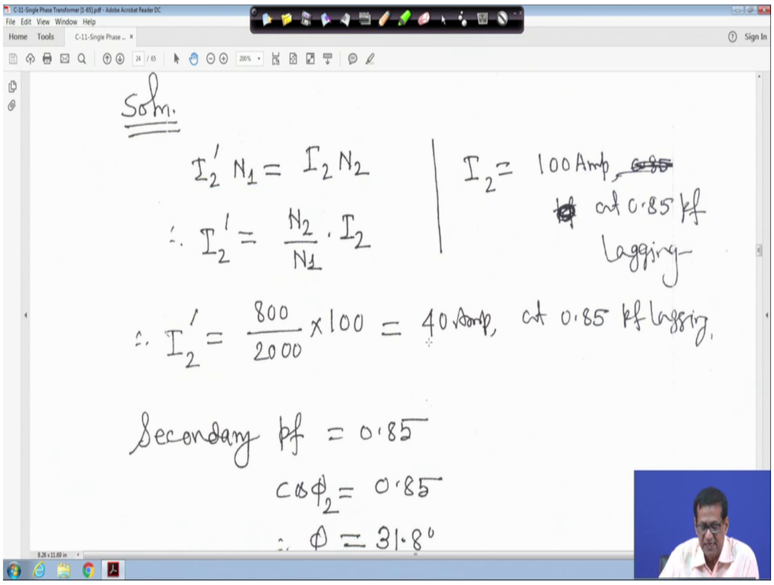

So, now we know I 2 dash N 1 is equal to I 2 N 2. Now, all formulas and known to you I 2 is 100 ampere at 0.85 power factor lagging, right therefore, I 2 dash is equal to N 2 upon and I 2 all the data are given. So, I 2 dash is compute 40 ampere and it is 0.85 lagging that is a I 2 dash.

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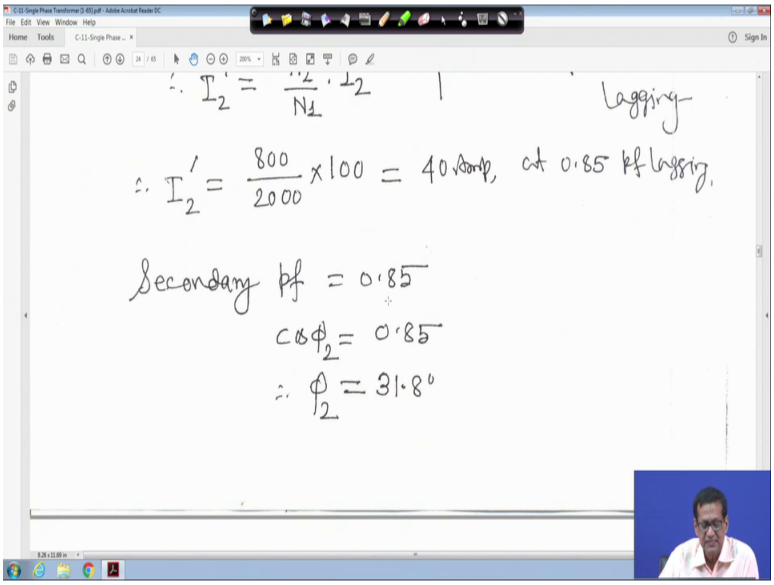

Now, secondary side power factor is power factor is 0.85. So, phi 2 is equal to 31.8 degree, right. So, this is your what you call that secondary side power factor that given, right it is the problem it is given, that your when the secondary current is hundred ampere at a power factor of 0.85 lagging.

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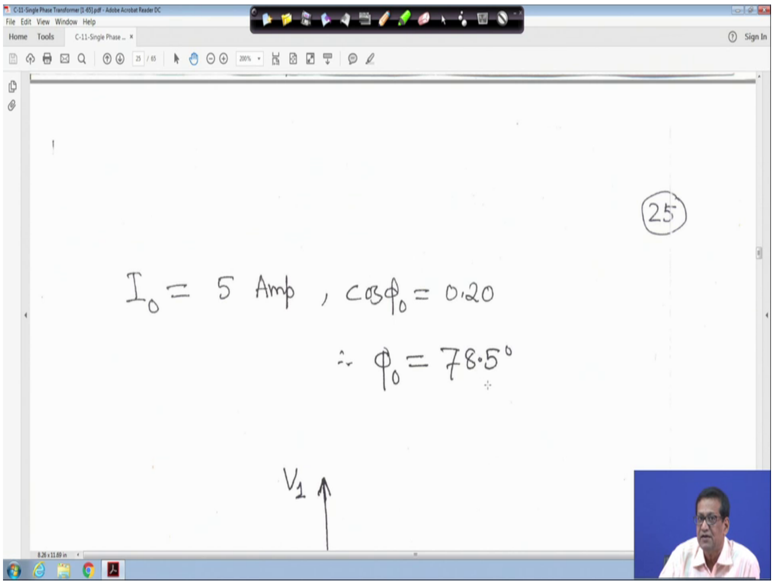

Now, I 0 is given 5 ampere and cos phi 0 is 0.2 is given. So, phi 0 is equal to 78.5 degree.

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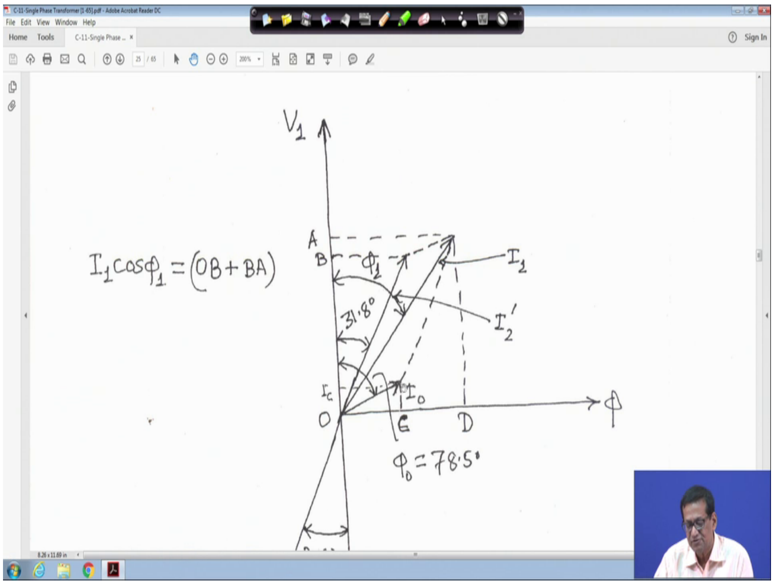

Now, if you draw the phasor diagram that phi as a reference and this is your V 1 at this is I 1, I 1 is equal to your I 0 plus your I 2 dash. And you and this is I 2.

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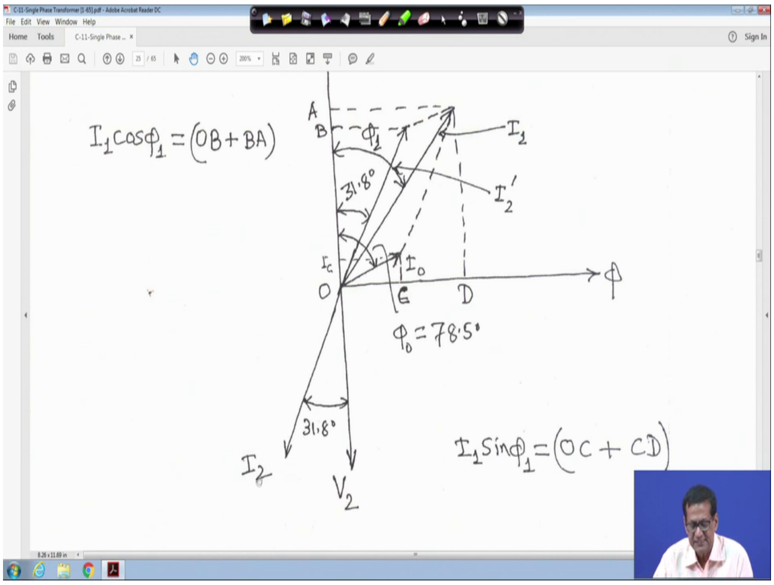

And I 2 and I 2 dash are in anti phase I told you that is why this is I 2 and this is your I 2 dash. So, this is look at the look at this your what you call curser and making it, right this is I 2 dash and this is my I 1 is equal to I 0 plus this thing and this phi 0, the angle phi 0 it is given that is 78.5 degree, right. So, that means, your I 1 cos phi 1 that is this is my I 1, and this is my your what you call that your cos phi 1 that is this OA, that OA is equal to actually OB plus BA. I am not writing here it is understandable just make it your projection on this your what you call on this y axis vertical axis say your V 1, right, so OB plus BA.

Similarly this side is if you make I 1 sin phi 1 is basically I 1 psi phi 1 is equal to OD that is nothing, but OC plus CD, right. So, all the angles are marked and your currents are also computed, right.

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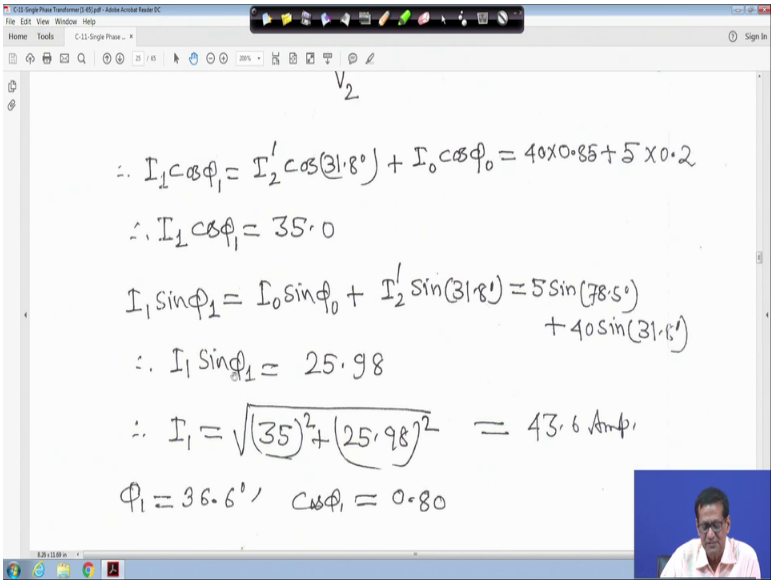

So, you can make it I 1 cos phi 1 is equal to I 2 dash cos 31.8 degree plus I 0 cos phi 0, right. Whatever it come, so I 1 cos phi 1 coming actually 35, right. So, if you make it this AB actually is nothing, but this component. Just do it little bit yourself you will get it very simple, right, but everything I am marked for you.

And similarly your I 1 sin phi 1 is equal to I 0 sin phi 0 plus I 2 dash sin are 31.8 degree. you will get your I 1 sin phi 1 is equal to 25.98. So, this I 1 cos phi 1 I 1 sin phi 1 you square and add it, right if you do so, you will get I 1 is equal to 43.6 ampere because sin square phi 1 plus cos phi 1 is equal to 1. And if you divide this I 1 cos phi 1, and I 1 sin phi 1 I 1 sin phi 1 by I 1 cos phi 1 you will get you divide it and get it phi 1. You will get tan phi 1 is equal to something, so phi 1 is equal to 36.6 degree. So, cos phi 1 will come you are what you call 0.8, right. So, this is the answer.

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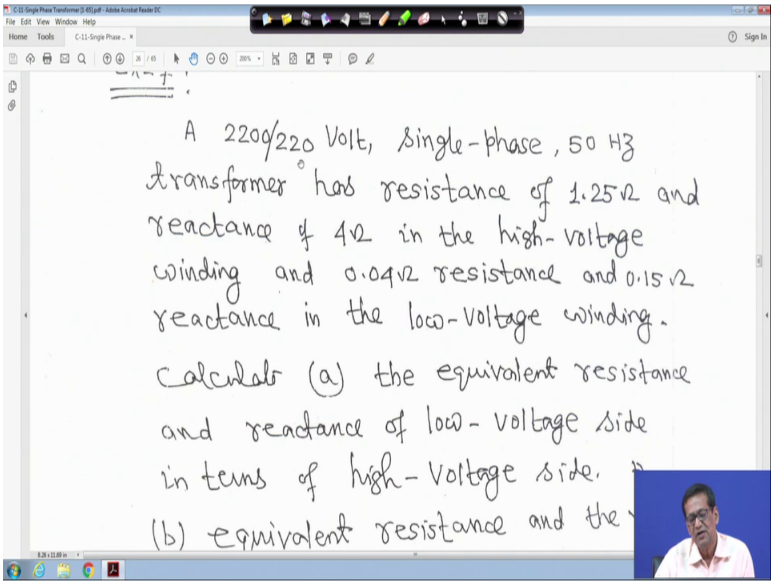

Another one is a 2200 220 Volt primary side this Volt secondary side this Volt step down transformer single phase 50 Hertz frequency is 50 Hertz are resistance 1.25 ohm, and reactance of 4 ohm in the high voltage winding. And 0.04 ohm resistance and 0.15 ohm reactance in the low voltage winding, it is primary side is this much and secondary side is this much is given, right.

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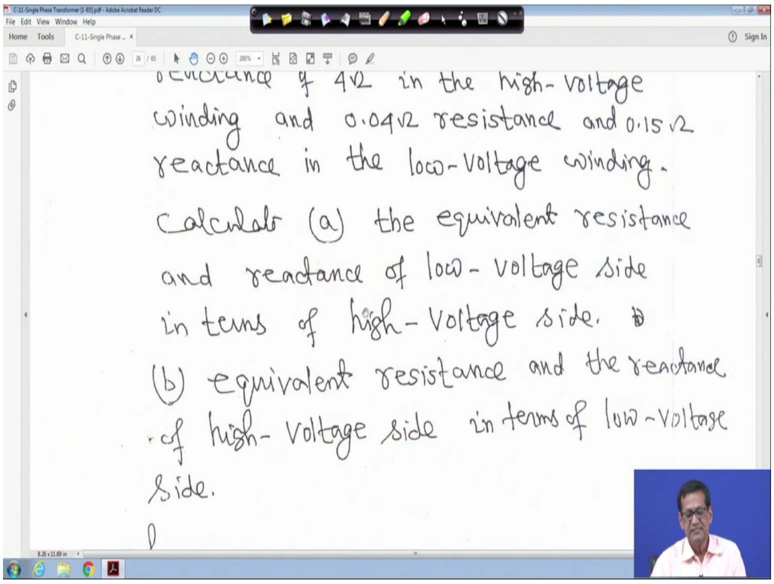

So, calculate the equivalent resistance and reactance of low voltage side in terms of high voltage side; b, equivalent resistance and reactance of high voltage side in terms of low voltage side both side you have to get it, right.

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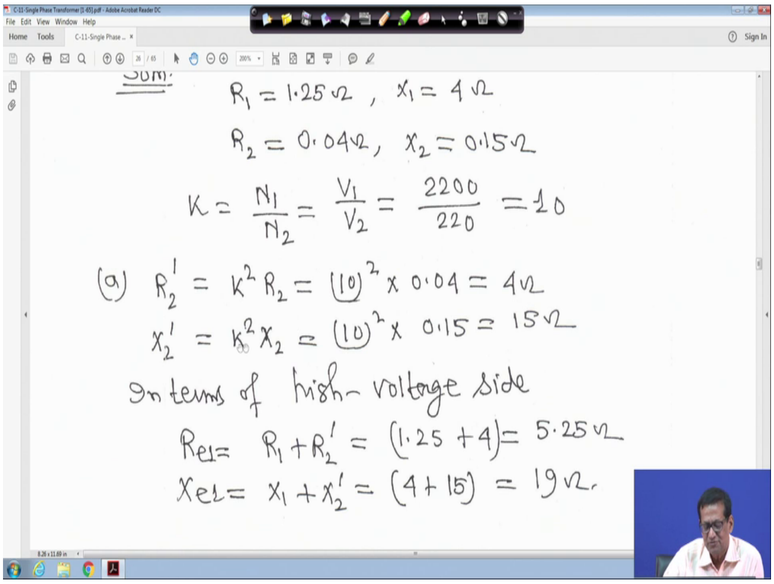

So, R 1 is given R 2 is given, X 1 is given X 2 X 2 is given. R 1 X 1 for primary side, R 2 X 2 for secondary side. K is also given N 1 by N 2 is equal to V 1 by V 2 is equal to this much is equal to 10, right. So, R 2 dash for the referred to the your what you call primary side R 2 dash will be K square R 2 that is 4 ohm, right all data you put, right and X 2 dash will be K square X 2. So, 10 square into 0.5, 15 ohm.

Therefore, in terms of high voltage side that is a primary winding, right, high voltage means here primary side the way we are made it, right here you are primary side is the high voltage side, right. Here it is high voltage side just this side your making primary side so, high voltage side.

So, in this case your what you call Re 1 will be R 1 plus R 2 dash you add will get 5.52 ohm. Similarly Xe 1 will be X 1 plus X 2 dash you add will get 19 ohm, right.

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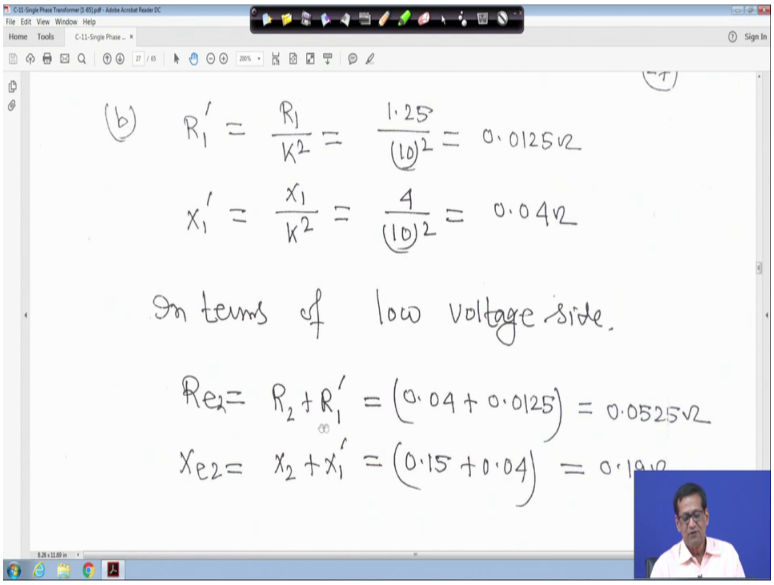

Now, B part is referred to the secondary side. In this case it will be divided that is R 1 dash will be that is because R 1 X 1 you have to transform to the secondary side not R 2 X 2, R 2 X 2 will remaining the secondary side all the in primary side your transforming the secondary side there is high voltage side you are taking the low voltage side. So, in that time high your high voltage side resistance reactance it has to be divided by your K square, so that is why R 1 upon K square. So, it is 1.25 over 10 square 0.125 ohm and X 1 will be X 1 dash will be X 1 upon K square it is 10.04 ohm.

So, in terms of low voltage side now that is your secondary side, right it is Re 2 is equal to R 2 plus R 1 dash you add it is 0.0525 ohm, right.

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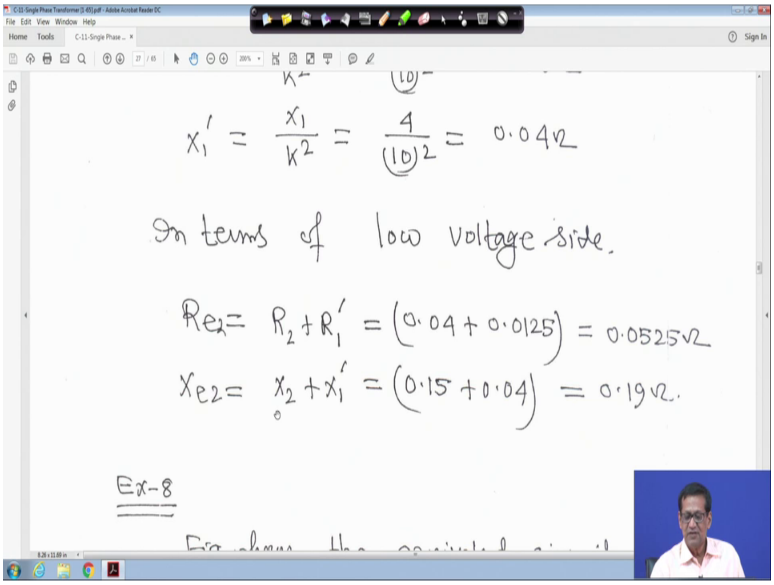

And X 2 dash if you add it will be your find your 0.19 ohm, right. But one thing look here it is 5.25 ohm, it is 19 ohm and secondary side it is 0.0525 ohm and if you want to bring whole thing to the your what you call your to the your primary your what you call primary side, if you multiply this by 100, 10 square it will be 5.25 ohm. And this one if you multiply by 10 square that is 100 you will get 19 ohm or vice versa, right from that you can check whether calculation is correct or not, right. So, this is one.

Thank you very much. We will be back again.