Analog Circuits
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Week -04
Module -01
Effect of feedback and stability

Hello, welcome to another module of this course analog circuits, we are now in the week four and in the previous module last week we had covered about feedback and the various effects of feedback like gain the sensitivity bandwidth enhancement increase in linearity.

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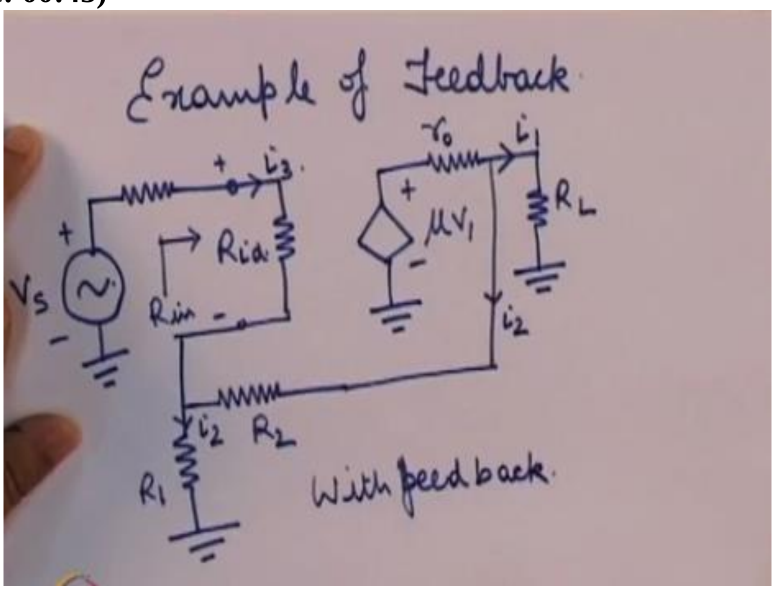

In this module let us see an example of feedback that is applied to a circuit suppose we have a circuit like this now the circuit this is with feedback and the circuit without feedback is like this.

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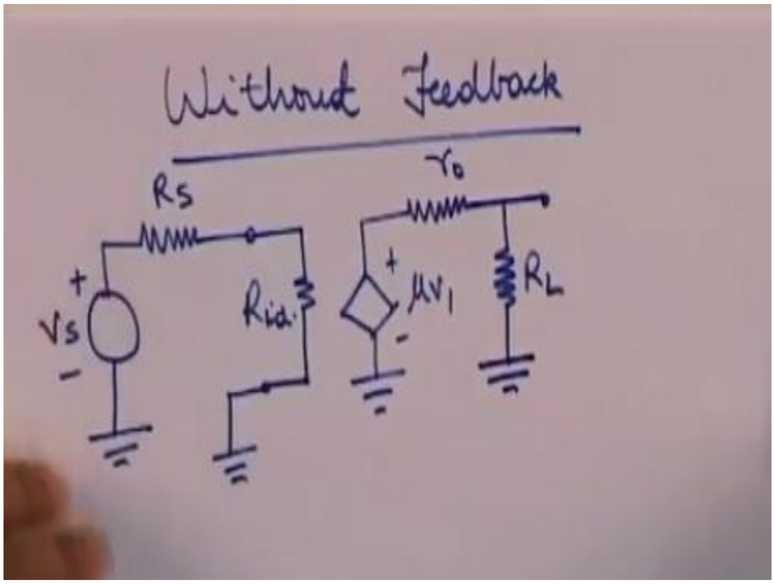

So after feedback the only difference between this circuit and this circuit is this additional resistance is R1 and R2 which are connected like this now what is the impact of these resistances on the overall performance, first note that here we are tapping the voltage at the output and feeding it back to the input at the input when we feedback what is happening is some portion of the input voltage that should have been applied directly is being subtracted by an amount equal to this voltage or by an amount equal to the voltage appearing across R1.

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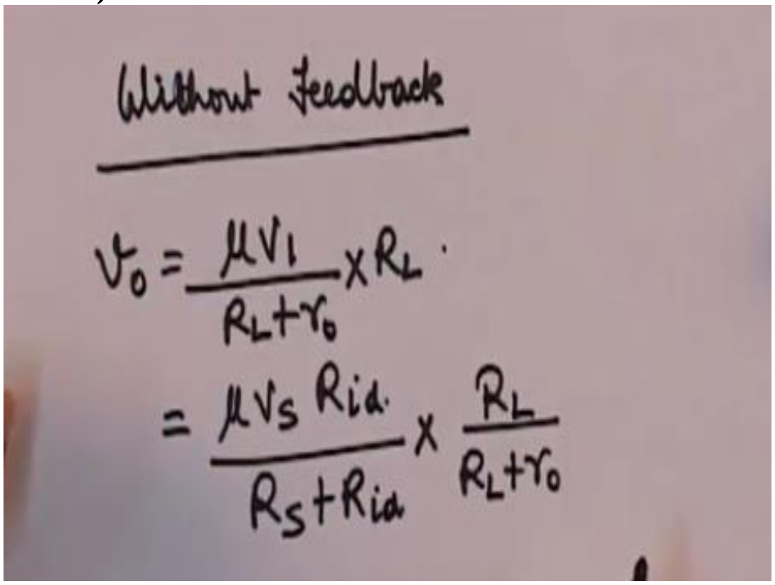

So this is an example of what we call voltage-voltage feedback it is a negative feedback but the type of negative feedback is voltage-voltage ok, so then what do we see what we see here is The output voltage V0 is given by mu V1 upon RL + r0 times RL which in turn is = mu Vs Rid upon

Rs + Rid times RL upon + r0 so this is my expression without feedback now with feedback my output voltage is given by an expression which is like this.

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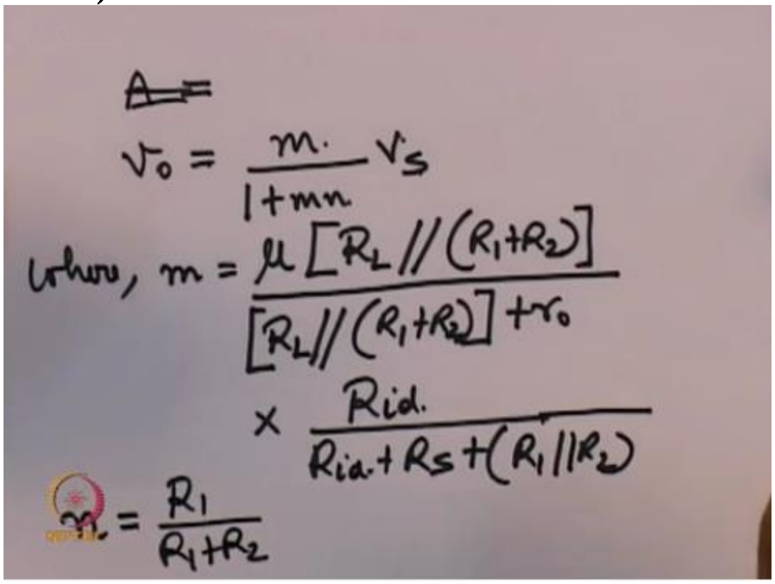

And this N is given as like this, now another effect of feedback which I did not discussed in the previous module was that the output and input impedances depending on of the kind of feedback that is provided the output and input impedances are also modified so for a voltage amplifier as you know.

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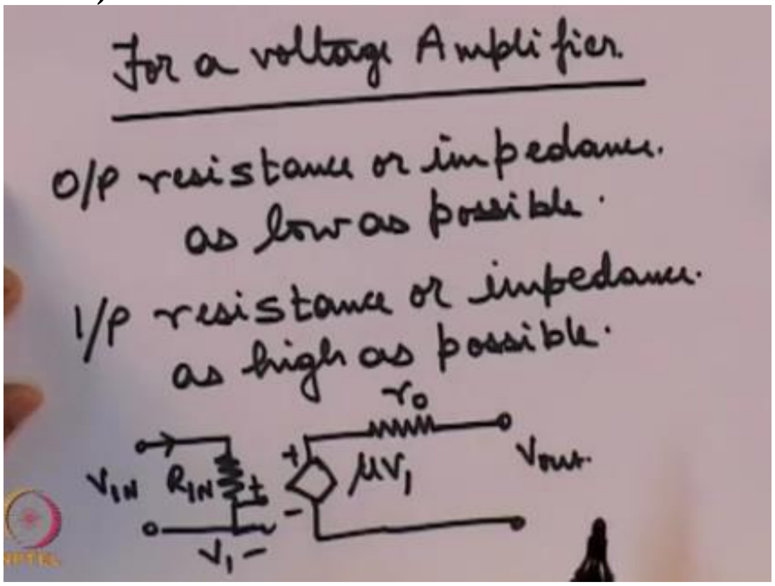

So for a voltage amplifier as you know output resistance or impedance as low as possible, why an input resistance or impedance as high as possible why is this because if we go back to the model of a voltage amplifier so in a voltage amplifier we have a voltage dependent voltage source an input voltage Vin with input impedance Rin any output impedance r0 and output voltage is Vo.

Now the reason this Rin should be as high as possible is because we want entire Vin to appear at the input okay should I should have mentioned, so this is V1 is the voltage that is actually appearing in the inside of the amplifier removed from RL and that voltage dependent voltage source produces an output mu V1 this is proportional to V1 this voltage V1 if Rin is not very high then there will be some current flowing through this Rin as a result of which the entire Vin will not appear at V1.

On the other hand if Rin is very high then no current will flow inside Rin and therefore the entire voltage Vin will appear at the input for the output however the scenario is different here we want this muV1 to appear completely at the output so to appear completely at the output it should face as less potential drop across this r0 as possible in other words this r0 should be as low as possible okay let me take a different example of suppose we have what is called a trans conductance amplifier.

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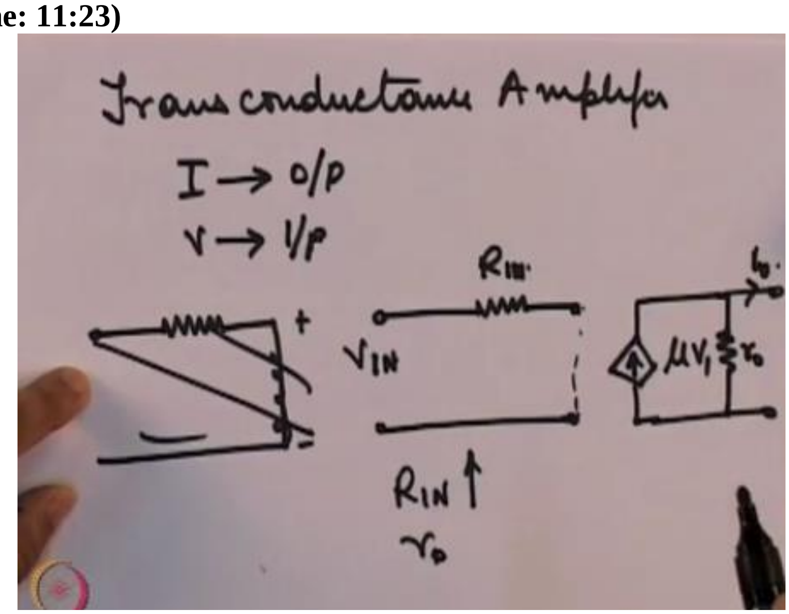

I at output that is current output and V at input and voltage input so for this trans conductance amplifier I should not I should not short this actually it should be like this I would like to correct the previous figure here it should not be shorted it should be open so this is open so it is like this

I mean open short basically this is the part where it is actually the voltage is being applied to the amplifier and for a trans conductance amplifier we will get a voltage dependent current source.

Now for a current source the output impedance is given as r0 okay so this is Vin and this is the output current Io for this case however the input conditions remain the same that is Rin as high as possible but this in this case r0 should be also as high as possible the reason being we do not want any part of this current source the current produced by this current source to leak into this R0 we want all of that current to go to I0 hence r0 should also be high so here we just disgrace a little bit about how the what kind of output impedances should be there for a voltage amplifier.

Voltage input voltage output amplifier and a trans conductance amplifier I leave it as an exercise for you to find out what should be the input and how high or how low the input impedances of an ideal current amplifier and that trans resistance amplifier should be so for a current amplifier the input is current output is current for a trans resistance amplifier input is current output is volt, so I leave it as an exercise for you to find out what should be the ideal values of the input and output resistances of such amplifiers.

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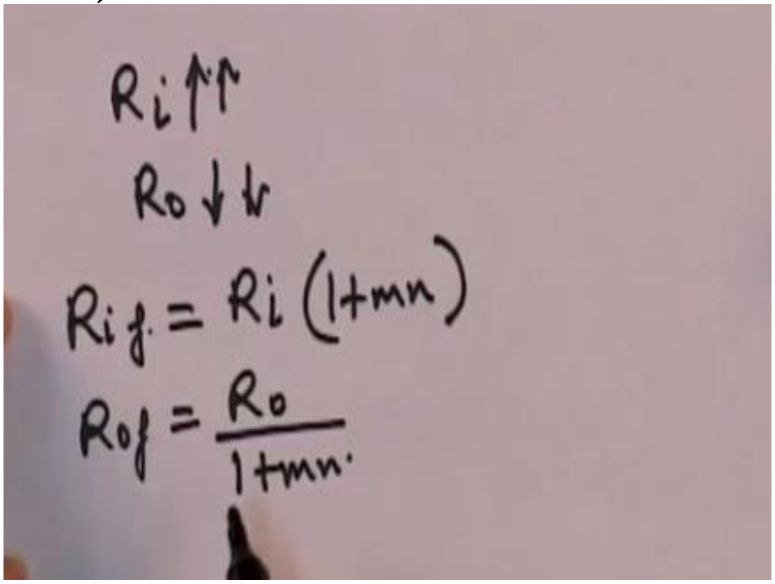

Now coming back to our to the voltage amplifier that we are studying so we should have the Ri as high as possible and Ro as low as possible it can be shown that this Rif with feedback the input impedance becomes like this and the output impedance with feedback becomes like this.

As you can see the input impedance with feedback is now significantly higher as compared to what was there initially and the output impedance is now significantly lower than what it was initially, so this is also one impact of feedback that we see that for voltage amplifiers where we apply voltage output tap the voltage at the output and feed it back as voltage to the input the input impedance increases the output impedance decreases or for a trans conductance amplifier.

What we will observe is that the where for a trans conductance amplifier of course we are taking current from the output and feeding it to the input as voltage in that case we will observe that the output impedance increases upon applying feedback and the input impedance also increases upon applying feedback so in this module we covered a sample analog circuit which was given a feedback of voltage-voltage feedback that is voltage from the output was fed back to the input as voltage.

What we observed is first of all the general feedback gain we got a gain expression we are with the feedback factor present and since the feedback factor was present therefore we would also get the other effects that we discussed in the previous module namely gain (()) (16:20).

Increase in linearity increase in bandwidth and in addition to that we also observed another effect that we had not discussed in the previous module that is the output impedance of this voltage-voltage of this amplifier with voltage-voltage feed the output impedance decreases and the input impedance increases, so in this module we shall end here in the next module we shall start with stability, thank you.