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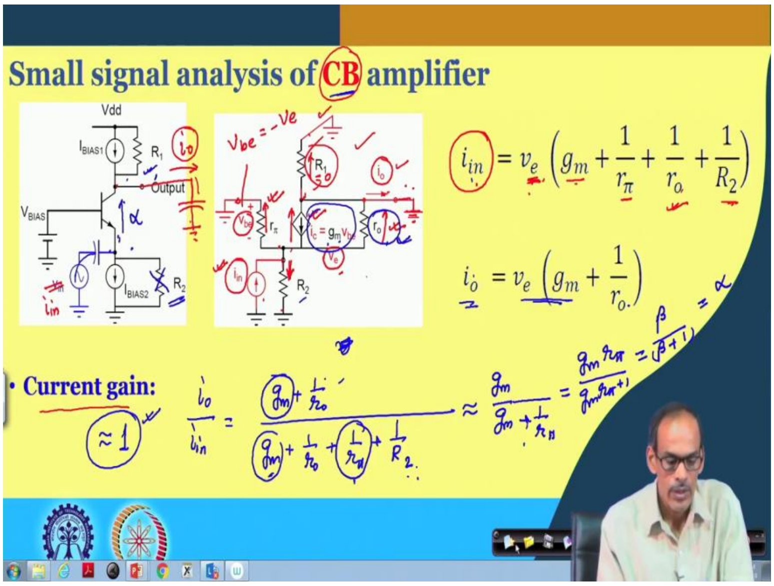

So, here we do have the common base configuration. We do have the corresponding circuit here and to get the current gain what we have to do? At the output node we have to make their corresponding terminal unloaded. What do you mean by unloaded? We have to basically short this node to ac ground and then we have to find how much the current it is coming from the circuit signal current. We are putting this capacitor, so that the operating point of the transistor it is not getting affected and at the same time signal wise we are observing the short circuit output current.

And we know that if the signal it is in current form unloaded condition should be the corresponding impedance or the terminating impedance should be 0. So, small signal model if you see the corresponding situation here it is this node the corresponding collector node it is ground and we are observing the corresponding signal current i_o, for their input signal it is i_{in}. In fact, in this case we are stimulating the circuit by signal current.

Now if you see this circuit again the base node it is grounded, voltage at the emitter we do have v_e. So, the v_{be} it is v_{be} it is $-v_e$ right and part of the current is also flowing here. So, we can say that i_{in}, it is having different component; one is this part another is this part right and then we also have this current and this current.

So, the if you see one by one this current it is $g_m v_{be}$. So, that is why $g_m v_e$ is the first part and then the second part here flowing through r_π, it is voltage here $\frac{v_e}{r_\pi}$. So, there is a second part and then we do have this part third part which is $\frac{v_e}{r_o}$ and then through this by a circuit which is $\frac{v_e}{R_2}$. So, in summary we can say that i_{in} it is it can be directly written in terms of v_e.

On the other hand if you see the current at the output terminal here. So, if this is the current. In fact, this current of course, this node it is grounded. So, the current here it is actually 0 because this is also ground this is also ground. So, the current here it is 0. So, the i_o on the other hand, it is summation of only these two currents we do have this current and we do have this current. So, i_o it is $v_e \times g_m$ and then we do have $\frac{v_e}{r_o}$.

So, if I take ratio of this two what we are getting here it is the v this is getting cancelled. So, the current gain $\frac{i_o}{i_{in}} = \frac{g_m + \frac{1}{r_o}}{g_m + \frac{1}{r_o} + \frac{1}{r_\pi} + \frac{1}{R_2}}$. In fact, if you see because this gm it is dominating we may consider rest of the things it is very small. In fact, you may call this is practically it is $\frac{g_m}{g_m}$. If you want you can probably keep this part or to be more precise it is we may drop this part. So, we can write this part and we can write this part.

So, it will be $\frac{g_m}{g_m + \frac{1}{r_\pi}}$. Of course, this R_2 can be ignored, definitely it can be ignored with respect to g_m, but whether this is ignore able with respect to r_π, r_o that depends on what kind of biasing arrangement we do have for the emitter terminal. But, whatever it is or we can write in this form and you can further simplify this as $\frac{g_m r_\pi}{g_m r_\pi + 1}$.

In fact, you may recall that $g_m r_\pi$ is nothing but the β of the transistor. So, this $\left(\frac{\beta}{\beta+1}\right)$. In fact, you may recall this is nothing but, α of the transistor that is very obvious. If I ignore this resistance if I feed a signal current here at the emitter whatever the current will be getting at the collector side, it depends on how much the current gain we do have from for this transistor from emitter to collector and that is nothing, but the α of the transistor.

So, we know that this α it is very close to 1. So, we can say that this current gain it is less than 1, but it is very close to 1. So, that gives us good you know conclusion that this circuit namely the common base, since its input resistance is low output resistance is high and the current gain it is it is close to 1. So, it is a good circuit for current mode buffer.

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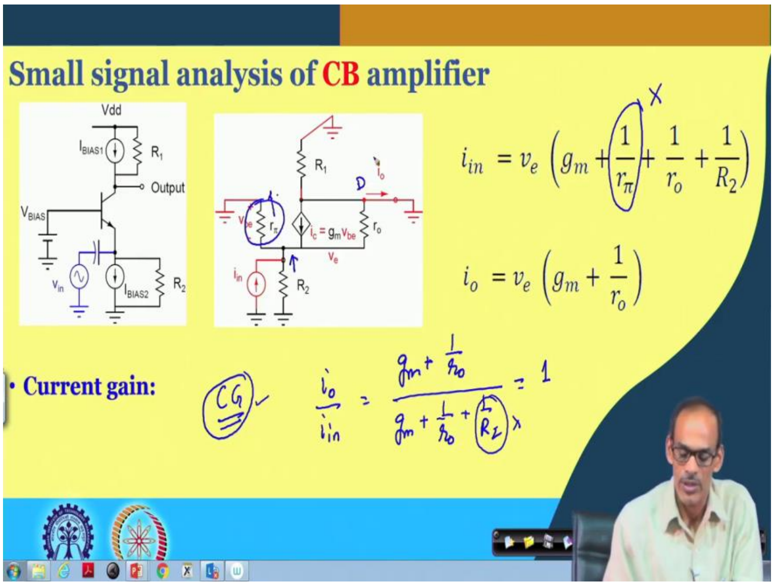

The similar kind of analysis it can be done for common gate also. I think you can do yourself just by dropping this part for that for common gate we simply remove this part and that gives us the corresponding current gain; $\frac{i_{out}}{i_{in}} = \frac{g_m + \frac{1}{r_o}}{g_m + \frac{1}{r_o} + \frac{1}{R_2}}$. In fact, for this case it is if I if I ignore this R_2 then it is exactly = 1 that is a very obvious. For BJT we do have this path which is taking some part of the current, but for most we do not have the get to source resistance.

So, as a result at the source whatever the current we give the entire current it is arriving to the drain terminal. I think most of the things we have covered.

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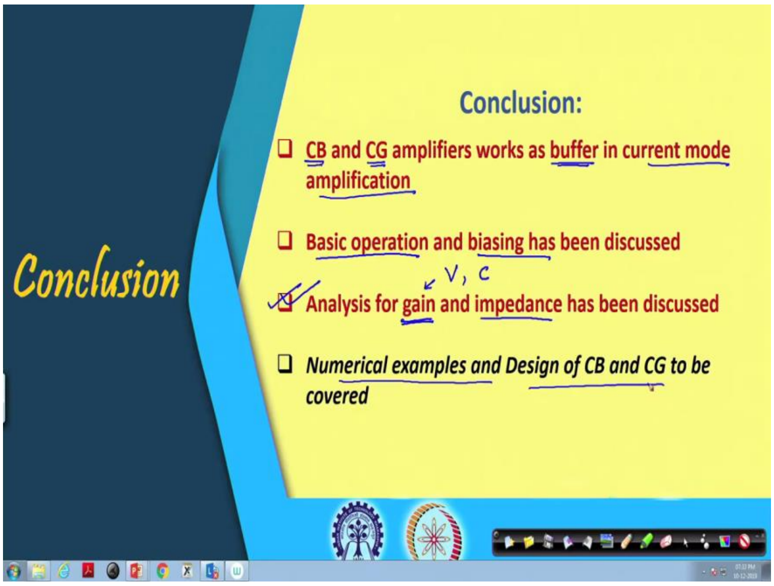

So, what are the things we have covered today? It is we have discussed about the common base and common gates amplifiers or configurations. It works as a buffer particularly for current mode amplification. What we have covered today it is the basic operation of these two configurations and we also have discussed a little bit about the different biasing schemes. Numerical discussion it will be done later. And then we have done full set of analysis of the small signal analysis of common base and common gate configurations to find the gain particularly voltage gain, input impedance and output impedance and also current gain. So, both voltage as well as the current gain, we have discussed. Numerical examples on these two configurations will be covering later. I think that all we need to cover.

Thank you.