Analog Circuits
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Module - 06
Lecture – 10

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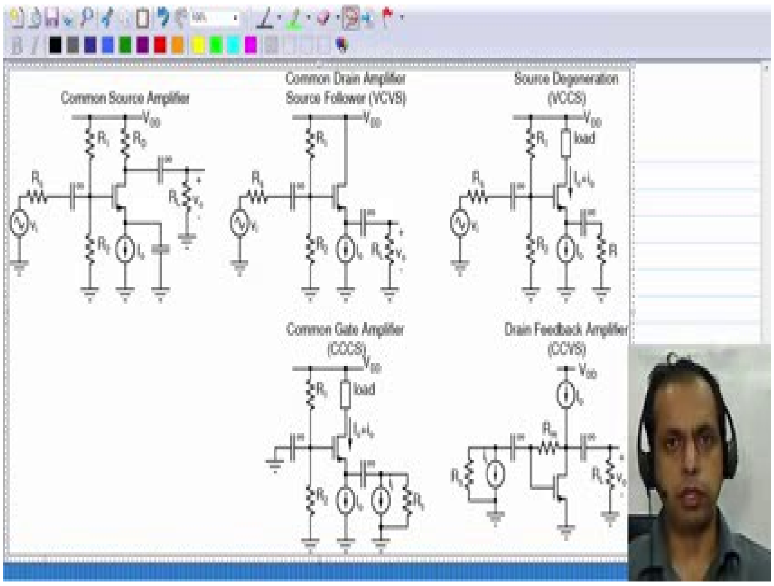

Now, we will have a quick summary of amplifier topologies we have discussed so far. A very first thing we discussed was the common source amplifier, and here I have shown the common source amplifier with source feedback technique for biasing of course, we can use other techniques as well. And after this we discussed the control sources we have common drain amplifier or the voltage controlled voltage sources here and source regeneration or the voltage controlled current source over there. I have shown the load as something in series with the drain. You can also use an inductor and ac coupled load. We also have the common gate amplifier which is a current controlled current source and drain feedback amplifier which is a current controlled voltage source.

Now, often it is common to see these three common source amplifier and common drain amplifier and common gate amplifier presented as basic stages. In our case, we have classified them somewhat differently; this is the basic amplifier without feedback; and all the four amplifiers incorporate feedback. Now, I repeatedly emphasize that it is important to understand the logic behind the circuit rather than trying to just memorize the circuit, you can see why because these circuits these all use the same biasing techniques, source feedback;

and they all kind of look the same also. So, if you did not understand the function of every component, you would not be able to distinguish between let us say this one that one and something that has the resistive load and something else and so on. So, these are the basic single transistor amplifiers.

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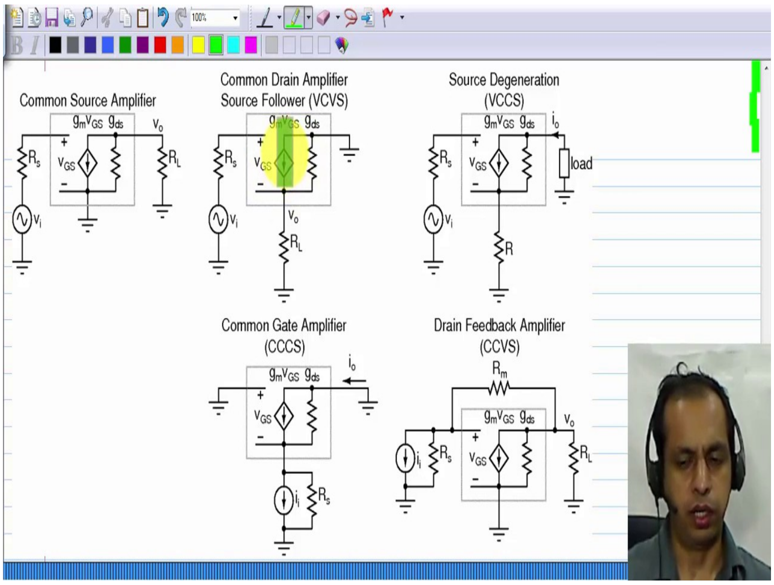

And their small signal pictures are given here. And you can analyse the transfer function or any other quantity input resistance output resistance and so on using this picture. In many of our analysis, we omitted g_{ds} , it does not have any profound effect, but in some cases it does you can still analyse them using linear circuit analysis. Now, I said that this amplifier does not have feedback whereas, all these do. How do you tell if there is feedback around the transistor or not? There is a systematic way of doing that. Now what is the meaning of there is feedback around a transistor; the transistor has a controlling side which is the gate source voltage and the control part which is the drain current.

Now, if any portion of the drain current is feedback as V_{GS} then we say that there is feedback. And if the feedback is in a particular sense then it is negative feedback. So, how do we evaluate if there is negative feedback what we do is the following; we set the independent input to the circuit to zero; we said V_i to zero that is not relevant here. And then transistor control source is replaced by a fixed current source and that is shown here.

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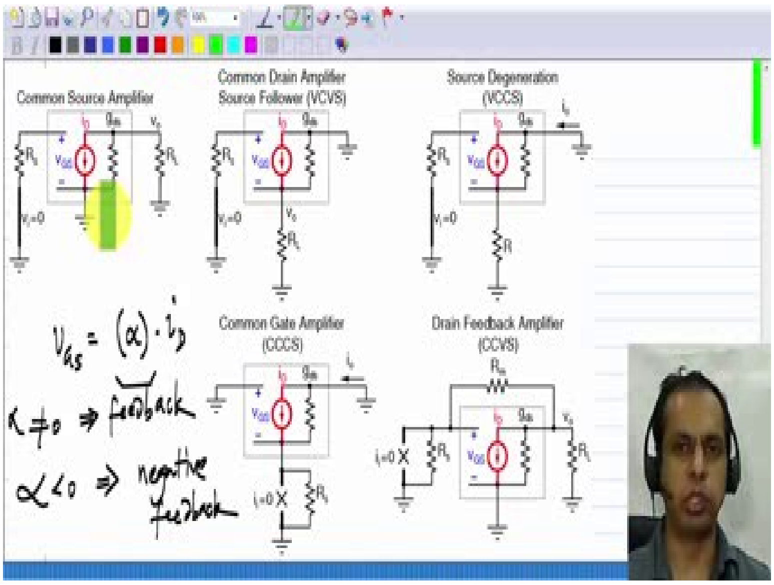

That is shown here we have set the input to zero V_i is zero here; it is replaced by short circuit; and i_i the current input is zero, so it is replaced by an open circuit. I have also replaced the control source inside the transistor with an independent current source i_D which is shown in red in each of these cases. So, what you do is the following; in these circuits, you find V_{GS}; If V_{GS} is not zero, remember in these circuits, the only sources this current V_i. And if the circuit happens have more than one dependent source, you set all of them to zero; the only independent sources remaining should be the one which is substituted in place of the control source within the transistor.

If this gate source voltage happens to be non-zero; that means that there is feedback somehow a part this V_i is going through the circuit and it is appearing as V_{GS}. now because these are all linear circuits, V_{GS} will be of the form of something times V_i. If this is not zero, there is feedback; let me just say α , $\alpha \neq 0$ implies there is feedback around the transistor. And if $\alpha < 0$,this means that there is negative feedback. These circuits are all quite easy to analyse you can do it one by one and see that V_{GS} turns out to be some negative number times V_i in these four cases whereas it will be zero in this case . So, this is how you tell if there is negative feedback; And if there is negative feedback, and it is very strong that is if g_m is very high then you can use the concept of virtual short to simplify your analysis this was discussed in one of the earlier lessons.