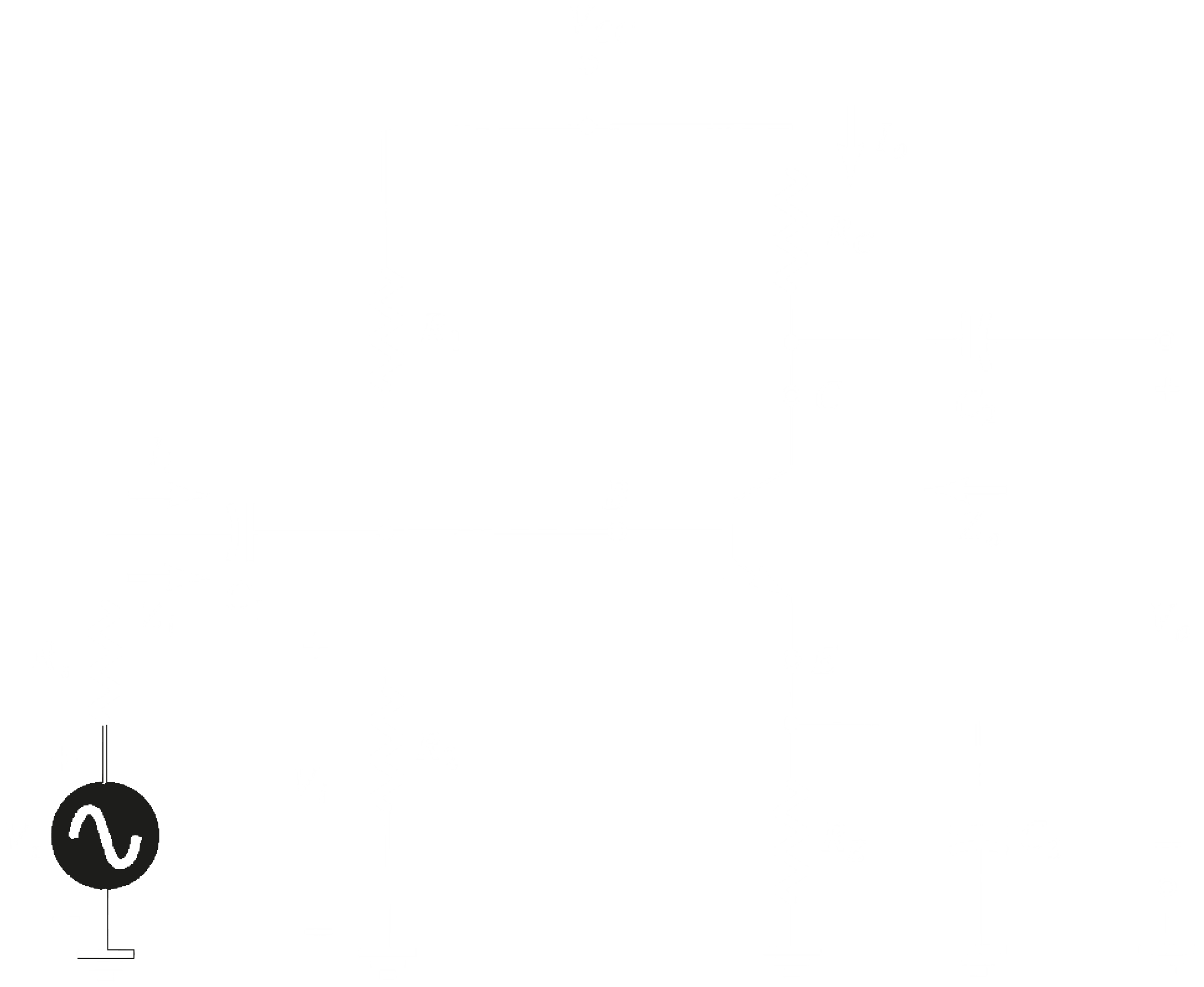
**Chapter 5: BJT AC Analysis**

So far, we have looked at DC biasing for a BJT, which allowed us to bring the BJT to the active region. Now, we will look at the actual AC signal amplification, with small signal analysis. Here, the total response at the operating point will be the combination of DC and AC signals.

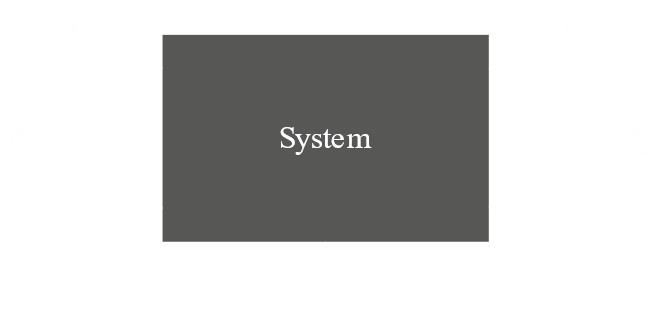
A small signal is a signal with a magnitude that is sufficiently small to keep the transistor inside the active region. To perform the analysis for small signal, we need to create an AC equivalent circuit. Take the following circuit for example:



First, we short all the DC connections and capacitors. Thus, we get a circuit like this:



Next, we need to replace the device, which is the transistor in this case. In order to do that, we need to model the AC equivalent of the transistor. There are three types of models, hybrid model, model and the hybrid model. We will look at the hybrid model first. The hybrid model makes use of a 2-port network.



Here, and .

Similarly,

Here, or is impedance, or is dimensionless, or is dimensionless and or is admittance.

is the input impedance where the output is shorted.

is the reverse voltage gain where the input is open-circuited.

is the forward current gain where output is shorted.

is the output admittance where input is open-circuited.

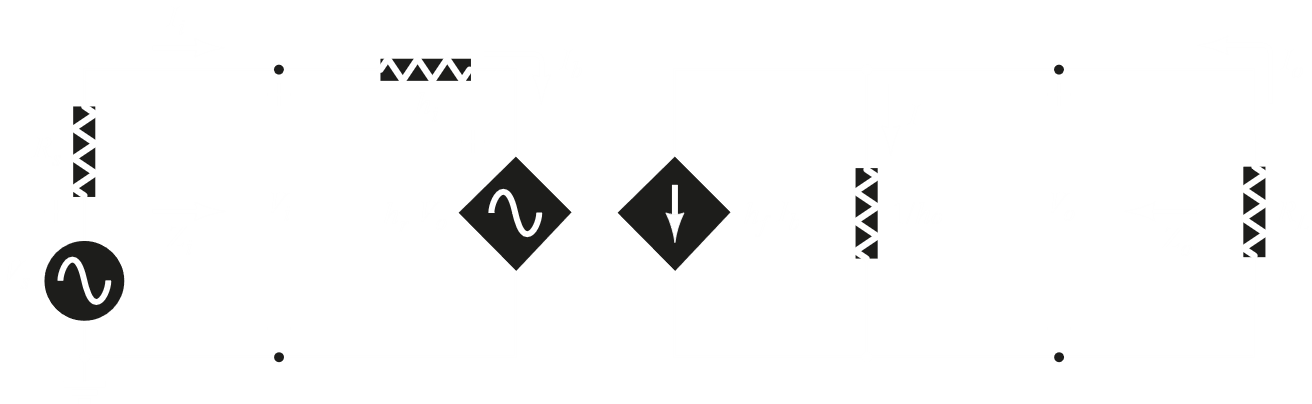
Thus, we can rewrite the previous equations as

For common emitter configuration, we use , , and . The notation for common base and common collector configurations is similar. For common emitter configuration, , , and .

and both give voltage results. and both give current results. Thus, the transistor’s AC equivalent can be modelled as:



Attaching this to the external circuit we get this:



For the above circuit,

Current Gain,

Applying Kirchhoff’s current law to the output circuit yields,

Substituting ,

Rewriting the above equation,

and

Thus,

Current Gain:

Voltage Gain:

Power Gain: