5.6 Small-Signal Operation and Models

Reading **Assignment**: 443-458

Now let's examine how we use BJTs to construct **amplifiers**!

The first important design rule is that the BJT must be biased to the **active mode**.

HO: BJT GAIN AND THE ACTIVE REGION

For a BJT amplifier, we find that every current and every voltage has two components: the **DC (i.e., bias) component**—a value carefully selected and designed by a EE, and the **small-signal component**, which is the AC signal we are attempting to amplify (e.g., audio, video, etc.).

HO:DC AND SMALL-SIGNAL COMPONENTS

There are two extremely important circuit elements in small-signal amplifier design: the **Capacitor of Unusual Size (COUS)** and the **Inductor of Unusual Size (IOUS)**.

These devices are just realizable approximations of the **Unfathomably Large Capacitor (ULC)** and the **Unfathomably Large Inductor (ULI)**. These devices have radically different properties when considering DC and small-signal components!

HO:DC AND AC IMPEDANCE OF REACTIVE ELEMENTS

It turns out that separating **BJT** currents and voltages into DC and small-signal components is problematic!

HO:THE SMALL-SIGNAL CIRCUIT EQUATIONS

But, we can approximately determine the small-signal components if we use the **small-signal approximation**.

HO: A SMALL-SIGNAL ANALYSIS OF HUMAN GROWTH

HO: A SMALL-SIGNAL ANALYSIS OF A BJT

Let's do an **example** to illustrate the small-signal approximation.

EXAMPLE: SMALL-SIGNAL BJT APPROXIMATIONS

There are **several small-signal parameters** that can be extracted from a small-signal analysis of a BJT.

HO: BJT SMALL-SIGNAL PARAMETERS

HO: THE SMALL-SIGNAL EQUATION MATRIX

Let's do an **example!**

EXAMPLE: CALCULATING THE SMALL-SIGNAL GAIN