SIMPLIFIED HYBRID MODEL

In most practical cases it is appropriate to obtain approximate values of A_V , A_i etc rather than calculating exact values. How the circuit can be modified without greatly reducing the accuracy. Fig. 4 shows the CE amplifier equivalent circuit in terms of h-parameters Since 1 / h_{oe} in parallel with R_L is approximately equal to R_L if 1 / h_{oe} >> R_L then h_{oe} may be neglected. Under these conditions.

$I_c = h_{fe} I_B$.

$h_{re} v_c = h_{re} I_c R_L = h_{re} h_{fe} I_b R_L$.

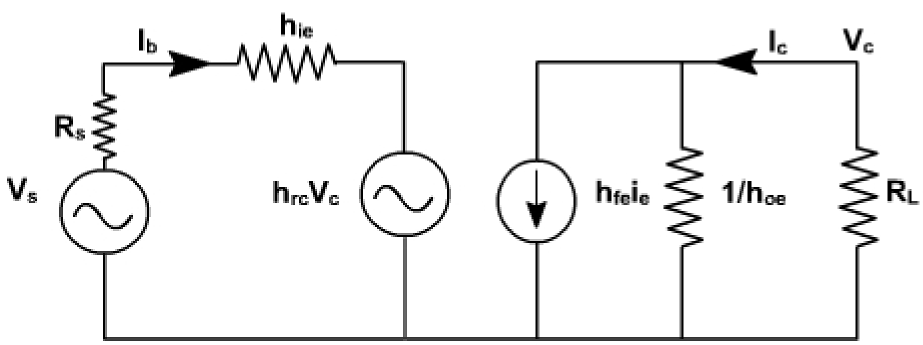

Fig. 4

Since $h_{fe}.h_{re}$ » 0.01, this voltage may be neglected in comparison with $h_{ic} I_b$ drop across h_{ie} provided R_L is not very large. If load resistance R_L is small than hoe and h_{re} can be neglected.

$$A_I = -\frac{h_{fe}}{1+h_{oe} R_L} \approx -h_{fe}$$

$$R_i = h_{ie}$$

$$A_V = \frac{A_I R_L}{R_i} = -\frac{h_{fe} R_L}{h_{ie}}$$

Output impedence seems to be infinite. When $V_s = 0$, and an external voltage is applied at the output we fined $I_b = 0$, $I_C = 0$. True value depends upon R_S and lies between 40 K and 80K.

On the same lines, the calculations for CC and CB can be done.

CE amplifier with an emitter resistor:

The voltage gain of a CE stage depends upon h_{fe}. This transistor parameter depends upon temperature, aging and the operating point. Moreover, h_{fe} may vary widely from device to device, even for same type of transistor. To stabilize voltage gain A_V of each stage, it should be independent of h_{fe}. A simple and effective way is to connect an emitter resistor R_e as shown in fig. 5. The resistor provides negative feedback and provide stabilization.

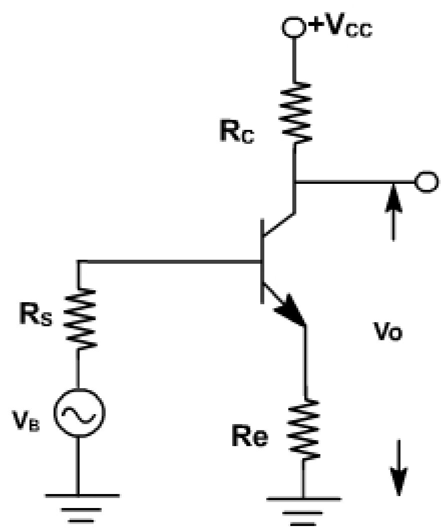

Fig. 5

An approximate analysis of the circuit can be made using the simplified model.

$$\text{Current gain } A_i = \frac{I_L}{I_b} = -\frac{I_C}{I_b} = -\frac{h_{fe}\ I_b}{I_b}$$

$$= -h_{fe}$$

It is unaffected by the addition of R_C.

Input resistance is given by

$$R_i = \frac{V_i}{I_b}$$

$$= \frac{h_{ie}\ I_b + (1+h_{fe})\ I_b\ R_e}{I_b}$$

$$= h_{ie} = (1+h_{fe})\ R_e$$

The input resistance increases by $(1+h_{fe})\,R_e$

$$A_v = \frac{A_i R_L}{R_i} = \frac{-h_{fe}\ R_L}{h_{ie} + (1+h_{fe})R_e}$$

Clearly, the addition of R_e reduces the voltage gain.

If $(1+h_{fe})R_e >> h_{ie}$ and $h_{fe} >> 1$

then

$$A_v = \frac{-h_{fe}\ R_L}{(1+h_{fe})R_e} \approx -\frac{R_L}{R_e}$$

Subject to above approximation A_V is completely stable. The output resistance is infinite for the approximate model.