TOPIC :- Expression for Voltage Gain in Different Frequency Ranges in R-C Coupled Amplifier

UG-II

In order to derive the approximate expression for the voltage gain of a single stage R-C Coupled amplifier, ~~employing the following~~ let us assume that-

(i) the bias resistors are of sufficient large value so that they do not affect the a-c operation of the circuit.
(ii) the reactance of the emitter bypass capacitor is zero.
(iii) the two transistors are identical.
(iv) the h_{re} and h_{oe} of each transistor are negligibly small.
(v) the h_{ie} and h_{fe} of the transistors do not vary with frequency.

Mid-Frequency Range:→ In this frequency range, the reactance of the coupling capacitor C_c is assumed to be zero, and the collector output capacitor and any stray capacitor, which appear in shunt across the output, are considered open-circuited. Hence if the transistor is replaced by its approximate h-parameter model, the equivalent circuit of the ~~first~~ stage of the RC-Coupled amplifier appears in fig (1). In this equivalent circuit h_{re} and h_{oe} are put to zero

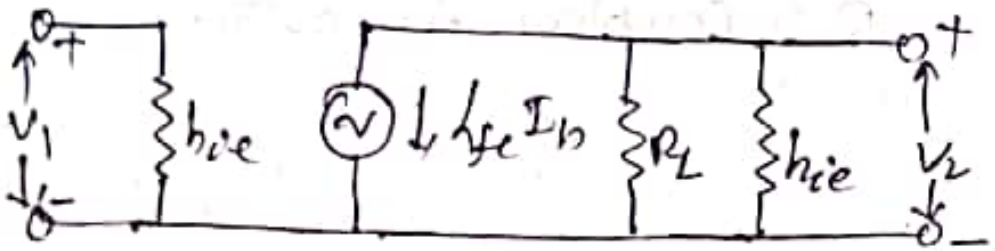

Fig 8(1)

The effective load resistance Z_L of the first stage of the amplifier is obtained from the relationship

$$\frac{1}{Z_L} = \frac{1}{R_L} + \frac{1}{h_{ie}}$$

or, $$Z_L = \frac{h_{ie} R_L}{h_{ie} + R_L} \longrightarrow (1)$$

Therefore, the output voltage V_2 is

$$V_2 = -h_{fe} I_b Z_L \longrightarrow (2)$$

and the input voltage V_1 is

$$V_1 = h_{ie} I_b \longrightarrow (3)$$

∴ The voltage gain in the mid-frequency range is given by

$$A_{vm} = \frac{V_2}{V_1} = -\frac{h_{fe} Z_L}{h_{ie}} = -\frac{h_{fe} R_L}{h_{ie} + R_L} \rightarrow (4)$$

The negative sign in eqn (4) indicates that there is a phase-shift of π radians between the output and the input signal voltage.