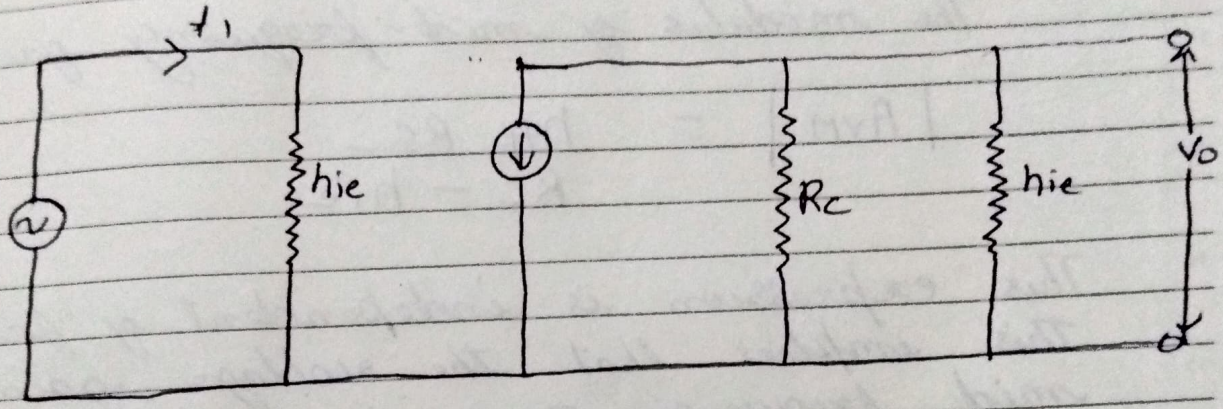
(i) Mid Frequency Range →

At mid frequencies the impedance offered by coupling capacitor is so small that it acts as a short while the impedance of shunting capacitor is so large that at acts as open and hence both may omitted from the circuit. Therefore the simplified equivalent circuit at mid frequency range is given in fig.



The output impedance Z is given by

$$\frac{1}{Z} = \frac{1}{Rc} + \frac{1}{hie} \quad \text{i.e} \quad Z = \frac{Rc\, hie}{Rc + hie}$$

The r.m.s value of input voltage $V_o = -h_{fe} i_1 Z$

The r.m.s value of input voltage is

$$V_i = i_1 hie$$

The voltage gain at mid frequency range is

$$A_{VM} = \frac{V_o}{V_i} = -\frac{h_{ie}\, i_1 Z}{i_1\, h_{ie}} = -\frac{h_{fe}\, Z}{h_{ie}}$$

$$= -\frac{h_{fe}\, R_C\, h_{ie}}{h_{ie}\,(R_C + h_{ie})}$$

The negative sign shows that phase shift of output signal reactive to input is 180°

∴ The modulus of mid-frequency gain is

$$|A_{VM}| = \frac{h_{fe}\, R_C}{R_C - h_{ie}}$$

This expression is independent of frequency. This implies that the voltage gain in mid frequency range is independent of frequency.

(ii) Low Frequency Range →

At low frequency the series reactance $(1/\omega C)$ of the coupling capacitor C is appreciable and varies with frequency, while the shunt reactance $\frac{1}{\omega_e C_{ff}}$ is large and hence in parallel it acts as an open. Accordingly the equivalent circuit at low frequency range simplifies to fig.

The r.m.s value of input voltage

$$V_{ie} = h_{ie}\, I_1$$