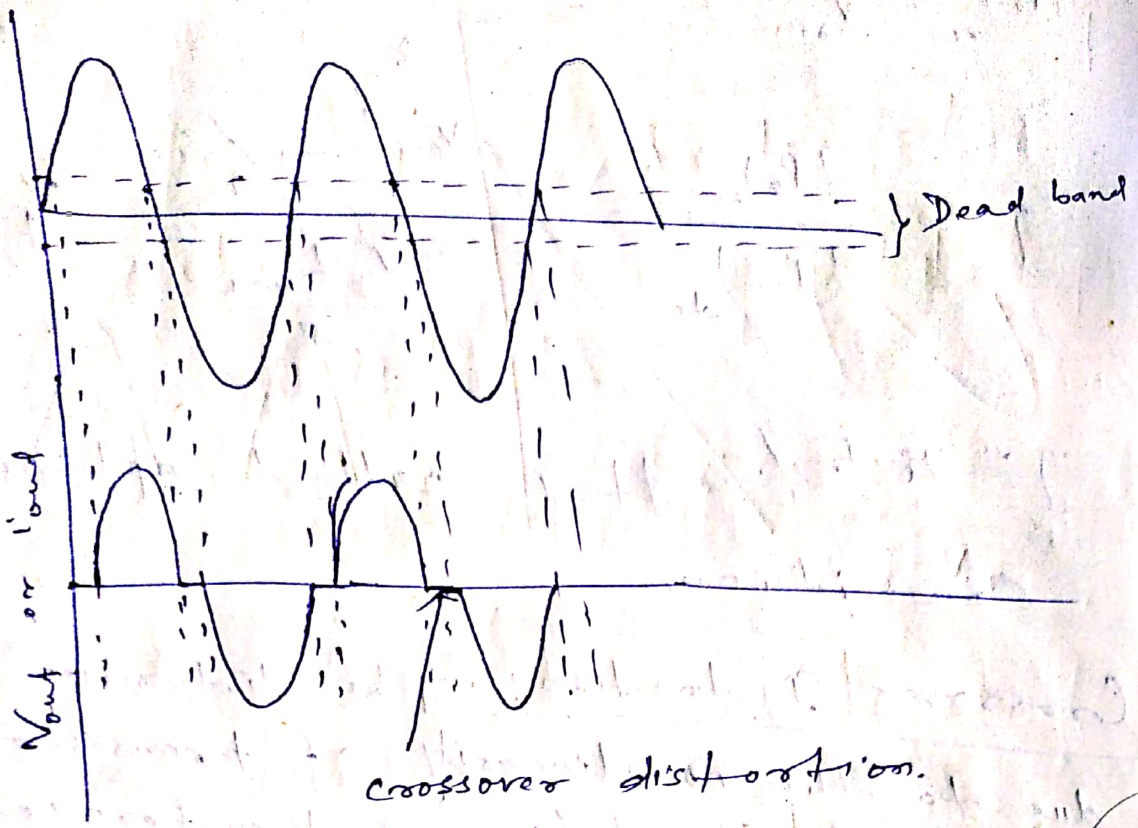
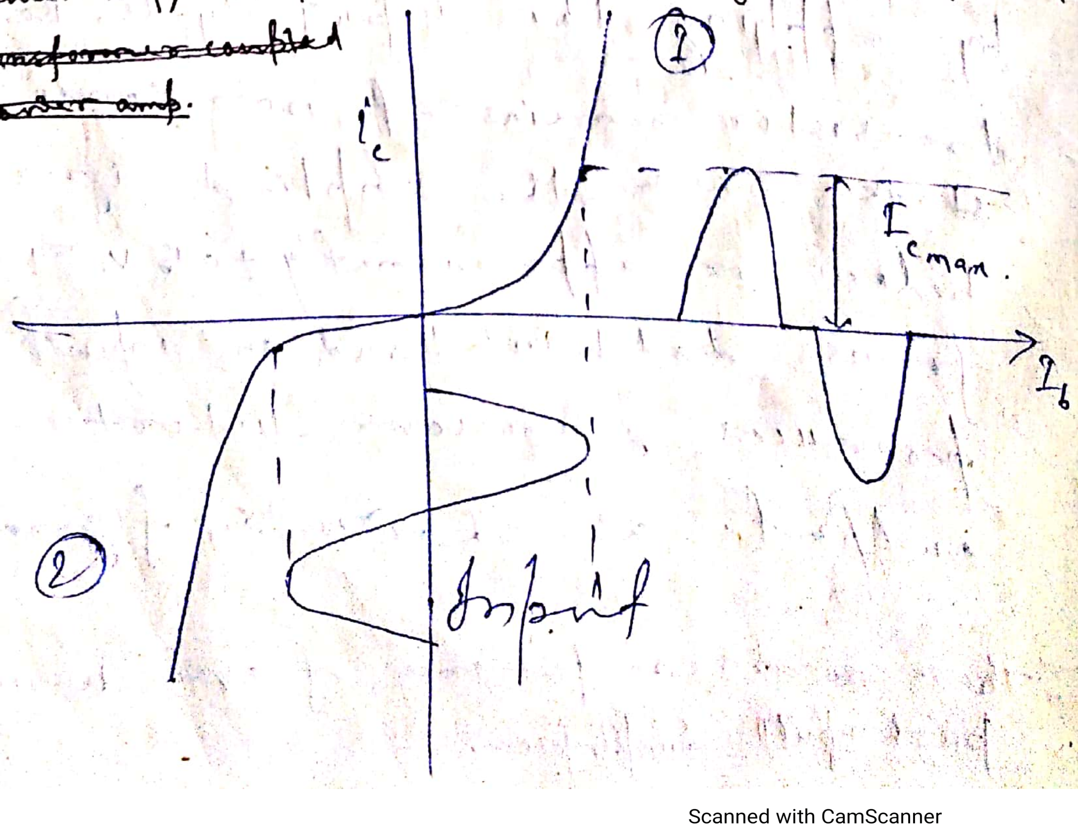
Crossover Distortion :- The distortion introduced due to the non-linearity of transistor and not proper matching of transformer. For forward biasing the emitter-base junction must have 0.7eV for Si and 0.3eV for Ge (sometime 1.5eV) as a barrier pot^n. For class B operation, there is no biasing ckt and base-emitter is forward bias by applying the input cycle. Both of transistor remains at non-conducting state when the applied signal is below or approximately ±0.5 V. This forms dead band band in input and produces a crossover distortion in output as shown in figure.

Note:- There ~~no~~ are no presence of even harmonics in push-pull amplifier.

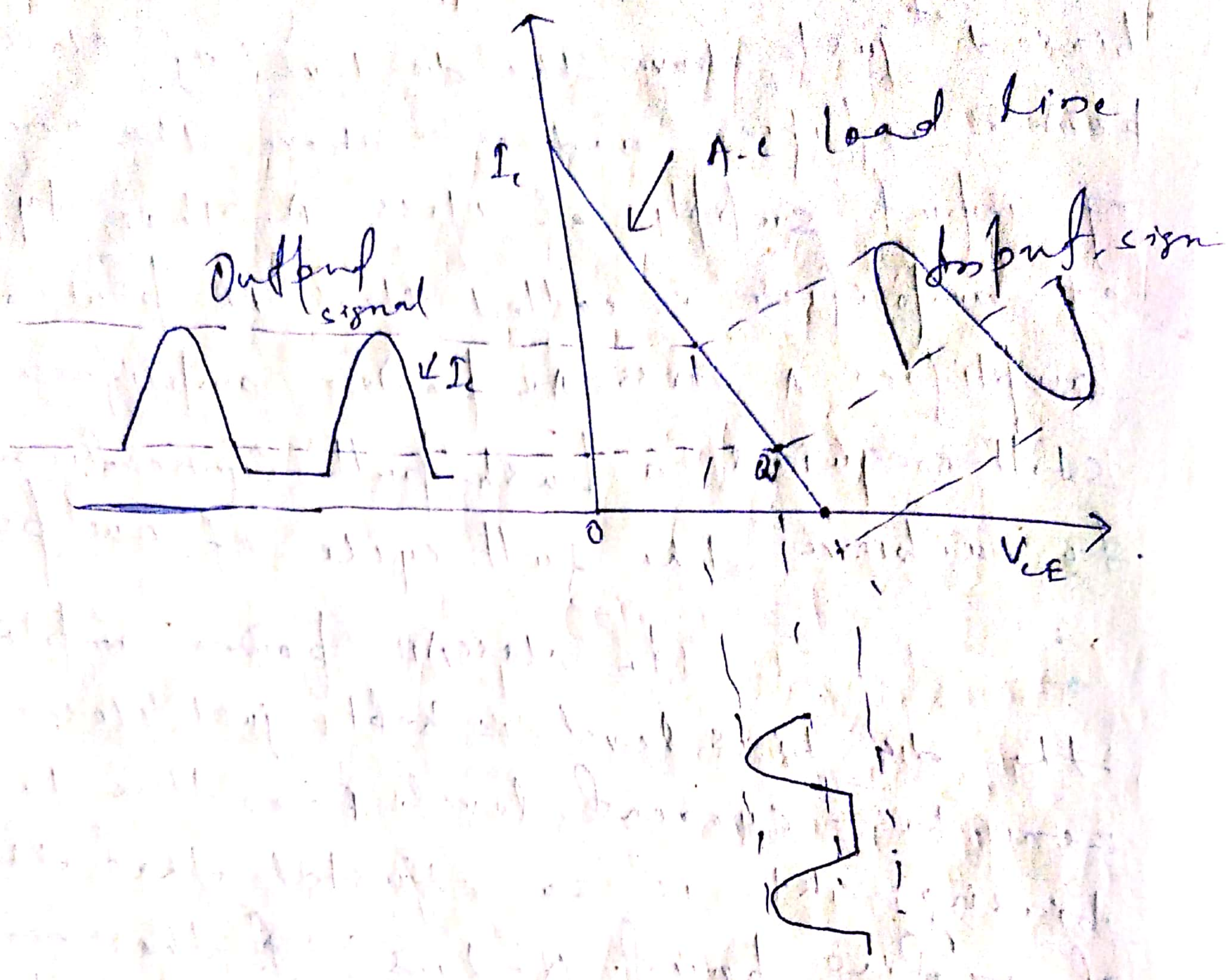


The distortion introduced is called crossover distortion because it occurs when the operation goes from one transistor to other transistor.
This cross-over distortion occurred in class-B push-pull power amp, is prevented ~~or~~ by using class-AB Push-Pull-
~~transformer coupled power amp.~~



Class AB Power amplifier :- An amplifier may be biased at just above the dc level of class B power amplifier and ~~one~~ above the one-half of input supply of class A. This type of amplifier is called class AB power amplifier. A class AB power amplifier still requires a push-pull connection to achieve the full-cycle of output.

In class AB power amplifier, the dc bias level is kept just closer to the zero-base-current level. For this the biasing ckt is so adjusted that the operating point Q- lies at the near of cutt-off voltage. i.e, in class AB power amplifier, the output current flows during ~~the~~ more than one-half cycle but less than a full cycle of input signal. Because during full +ve half-cycle and a small portion of -ve half, the input ckt is forward biased.


A.c load line
Input signal
Output signal
I_c
I_c
Q
0
V_{CE}

Tuned Amplifier

Amplifiers are classified on the basis of operation in frequency range as discussed below —

i) d.c amplifier (Amplifies of 0–10Hz freq.

ii) Audio-amplifier (20Hz — 20KHz)

iii) Radio-amplifier (A few kHz to hundred of MHz)

An audio-amplifier can be operated at radio-frequency but they suffer from two major drawbacks. (i) firstly, their efficiency falls or drops at radio-frequency and (ii) secondly they do not permit the selection of a specific radio-frequency. Sometime we require the selection of a specific radio-frequency for the amplification. For example, when a RF signal of specific frequency (or single frequency + Modulated wave) from different broadcasting station reaches to the receiving antena, then a weak signal is induced in it. To extract the original signal from this received signal, it is necessary to amplify it. This is achieved by radio-receiver with the help of tuned amplifier.

An amplifier which selects and amplify a specific frequency or narrow band of frequency is known as tuned amplifier. A tuned amplifier is mostly used for the amplif of very high freq i.e. radio frequency because generally, radio frequency is single freq.

A tuned amplifier can not be used for the amplification of audio-frequency because of following regions ——

i) A tuned amplifier selects and amplify a specific of frequency ~~from to~~ while rejecting all other signal. whereas, audio-frequency belongs ~~to~~ from 20 Hz to 20kHz i.e audio-frequencies are the mixtures of 20Hz to 20kHz. It is required equally amplification for all these frequency for the proper reproduction Hence a tuned amplifier can not be used for the audio signal. Usually, RF signal is single while, audio-signals (or audio freq.) are mixtures.

ii) Tuned ckt consist of inductor and capacitor. For the amplification of low frequency, large value of L and C ~~are~~ is required as tuned ckt or frequency selection based on resonance phenomena. The large value of L and C makes the ckt bulky and expensive.

Thus, a tuned amp. performs the following two work ——

i) Selection of a specific RF frequency (single freq) from a particular broadcasting station.

ii) Amplification of selected RF signal.

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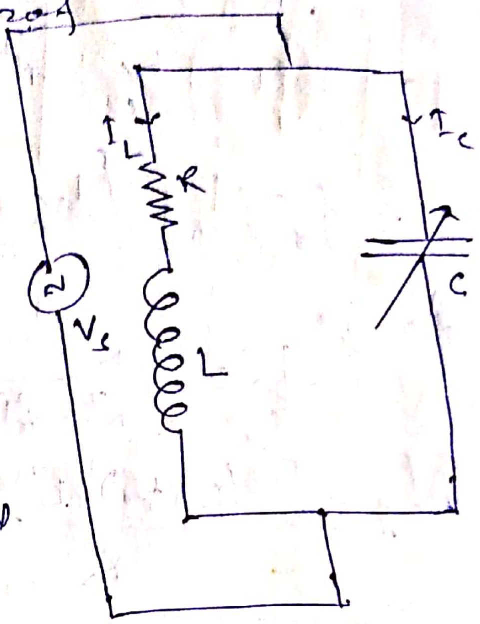
Fundamental of Tuned circuit :- A parallel tuned circuit consist of parallel combination of a variable capacitor and inductor. sometime inductor is also variable. It is shown in fig.

An ideal inductor does not dissipate heat and corresponding to it there is no resistance offered by inductor. But, practically some resistence is offered by inductor.



At a particular frequency of applied voltage, the capacitive reactance and the inductive reactance becomes equal and ckt becomes purely resistive. This phenomena is called Resonance

At resonance, —

$$X_L = X_c \quad , \quad I_L = I_c$$

$$\Rightarrow 2\pi f_r L = \frac{1}{2\pi f_r C} \qquad \Rightarrow f_r = \frac{1}{2\pi}\sqrt{\frac{1}{LC}}$$

The impedance offered by ckt ———

$$\frac{1}{Z} = \frac{1}{X_L} + \frac{1}{X_c'} = \frac{1}{R+j\omega L} + \frac{1}{1/j\omega C}$$

$$\text{or, } 1/Z = \frac{R-j\omega L}{R^2+\omega^2 L^2} + j\omega C = \frac{R}{R^2+\omega^2L^2} + j\omega\left[C - \frac{L}{R^2+\omega^2L^2}\right]$$

At resonance the reactive component becomes zero

$\therefore j\omega\left[C - \frac{L}{R^2+\omega^2L^2}\right] = 0$

or, $\frac{L}{R^2+\omega^2L^2} = C$ or, $R^2+\omega^2L^2 = L/C$

or, $\omega^2L^2 = L/C - R^2$ or, $\omega^2 = \frac{L}{C} - R^2/L^2$

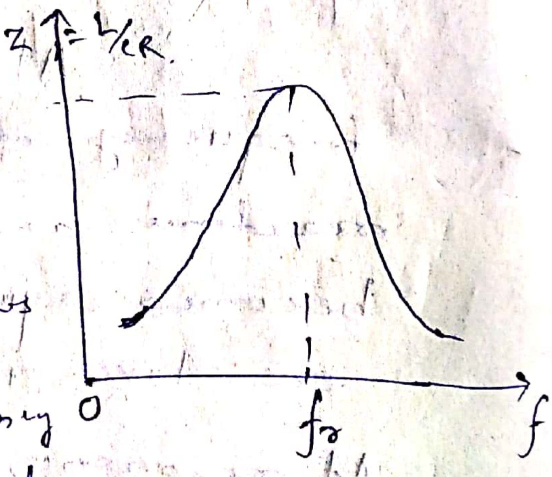
$\therefore f_r = \frac{1}{2\pi}\sqrt{L/C - R^2/L^2}$

And,

$$\frac{1}{Z} = \frac{R}{R^2+\omega_r^2L^2} \approx \frac{R}{\omega_r^2L^2}$$

or, $Z = \frac{(2\pi f_r)^2L^2}{R} = \frac{L^{\cancel{2}}}{R}\cdot\cancel{4\pi^2}\cdot\frac{1}{\cancel{4\pi^2}}\cdot\frac{1}{\cancel{L}C}$

$\Rightarrow \boxed{Z = \frac{L}{CR}}$



The variation of impedance with freq. as shown in adjacent figure. Fig. shows that impedance decreases on both sides of frequency rapidly and having maxm value at resonance frequency. In this way the tuned ckt selects the resonance freq. and rejecting all others. This property gives the selectivity property of a tuned ckt.

Q-factor :- Quality factor is defined as the ratio of inductive reactance to the resistance offered by inductor at resonance frequency.

i.e, $\boxed{Q = \frac{X_L}{R}}$

Bandwidth :- The frequency range at which the impedance of tuned amplifier decreases to 70.7% is called bandwidth and it depends upon resonance freq. and Q-factor as given below —

$$\boxed{f_2 - f_1 = \frac{f_r}{Q}}$$

Advantages of tuned amplifier :- ~~It has~~

i> **High selectivity** :- A tuned amplifier has high selectivity and it can selects and amplify a high frequency out of a no. of frequencies simultaneously impressed on it.

ii> **Small collector supply voltage** :- It requires a small collector supply voltage because its resistance is negligible.

iii> **Small power gain** :- The tuned ckt employs cap and inductor which has low power dissipation.

SINGLE tuned Amp.

The figure shows single tuned amplifier. Here the output is obtained by ~~inductive coupling~~ capacitive coupling and inductive coupling. The signal to be amplified is applied ~~across~~ betn base and emitter. R_1, R_2 and R_e form the biasing ckt and stabilization ckt. C_e is the bypass cap. The tuned ckt consist of variable

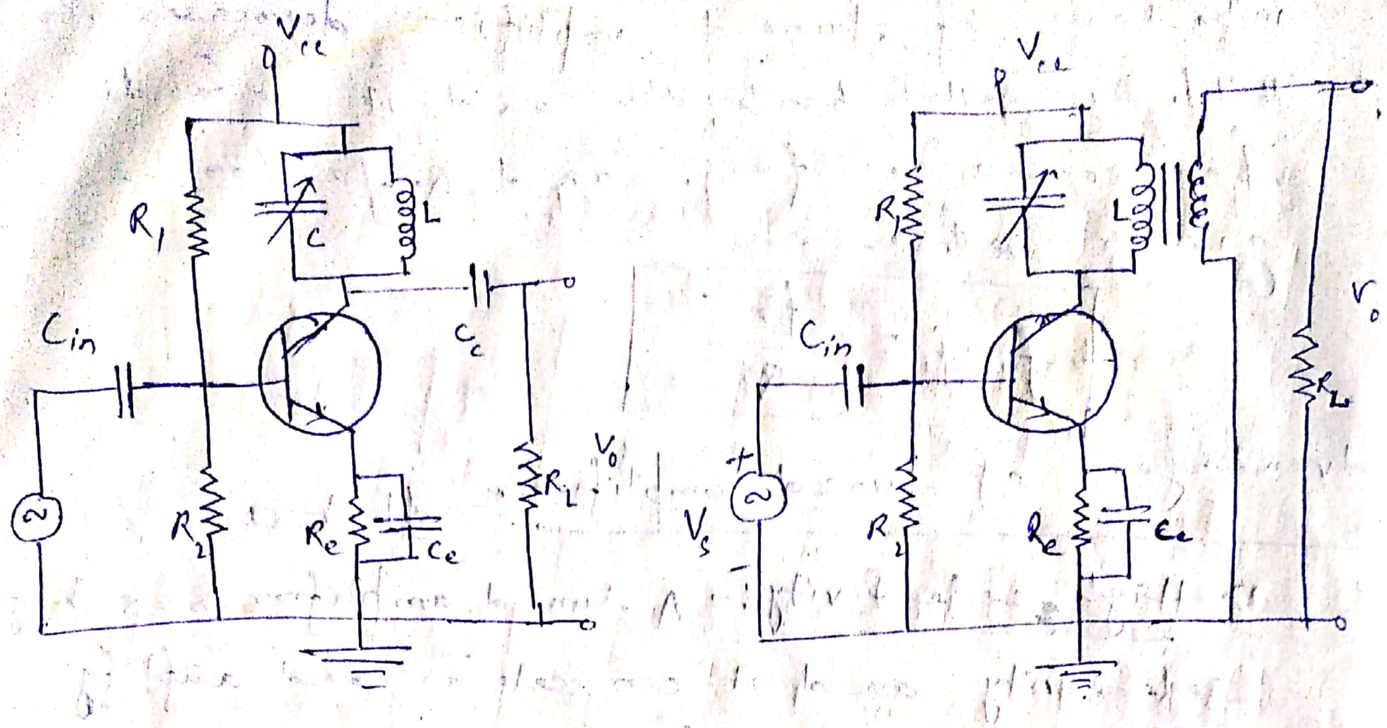


fig-1 fig-2

capacitor and inductor in parallel combination acts collector load. Sometime inductor is also variable. The value of variable capacitor and inductor is so adjusted that the resonant frequency becomes equal to the frequency of signal applied to be amplify.

Circuit operation :- The high frequency signal to be amplify is applied across base and emitter. The value of C and L are so adjusted that the resonant frequency of the ckt becomes equal to the freq. of applied signal to be amplify. At resonant frequency, tuned ckt offers ~~ve~~ maximum impedence and thus a large output appears across load. If signal is complex (consisting many frequency), only the resonant frequency is selected and amplified and all other are rejected.

Circuit operation

The voltage gain of an amplifier (CE) —

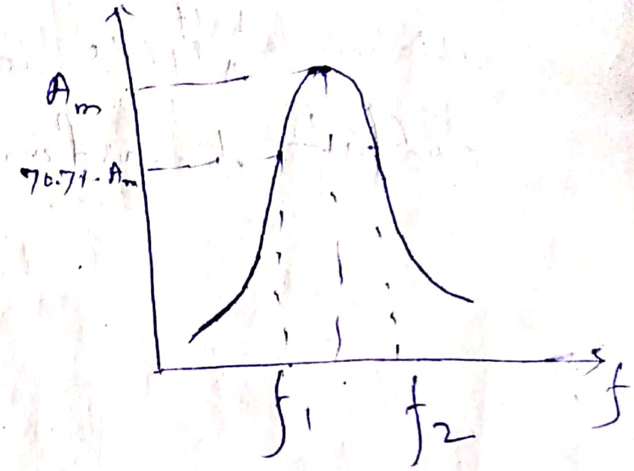
$$A_v = \frac{V_o}{V_{in}} = \frac{I_c R_{ac}}{I_b r_{in}} = \frac{\beta \cancel{I_b} R_{ac}}{\cancel{I_b} r_{in}} = \frac{\beta R_{ac}}{r_{in}}$$

$$A_v = \frac{\beta R_{ac}}{r_{in}}$$

where R_{ac} = Resistance of tuned ckt

r_{in} = Input resistance.

since $R_{ac} = \frac{L}{CR}$,



$$\therefore \quad A_v = \frac{\beta L}{CR\, r_{in}}.$$

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