ANALOG CIRCUITS ASSIGNMENT

Submitted By
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ECE S4 -B
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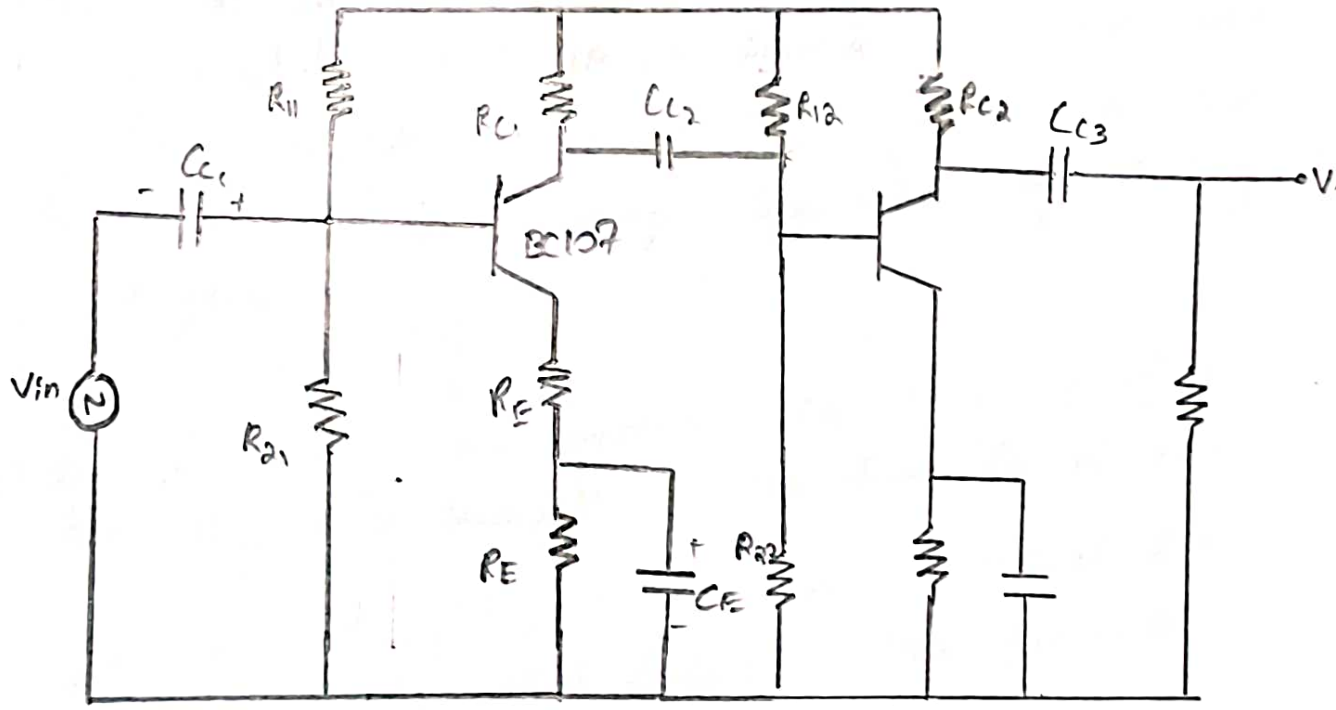
Q1 With schematic explain a two stage RC coupled amplifier. what are the effect of cascading in gain and bandwidth of amplifiers. ?

Ans: Multistage amplifiers are used for cascading to improve parameters suchas voltage/current gain, input/output resistance. A two stage amplifier provides an overall voltage gain of A_1 and A_2 which are the gains of first and second respectively. Since each stage provides a phase reversal. the input and output signal will be in phase.



The input of second stage is in parallel with R_{C1} of the first stage. The voltage gain of the first stage is

$$A_1 = \frac{R_{C1} \parallel R_{i2}}{r}$$

where R_{i2} is the input resistance of the second stage

$$R_{i2} = R_{12} \parallel R_{22} \parallel (1+h_{fe}) r_e$$

$h_{fe} = 100$

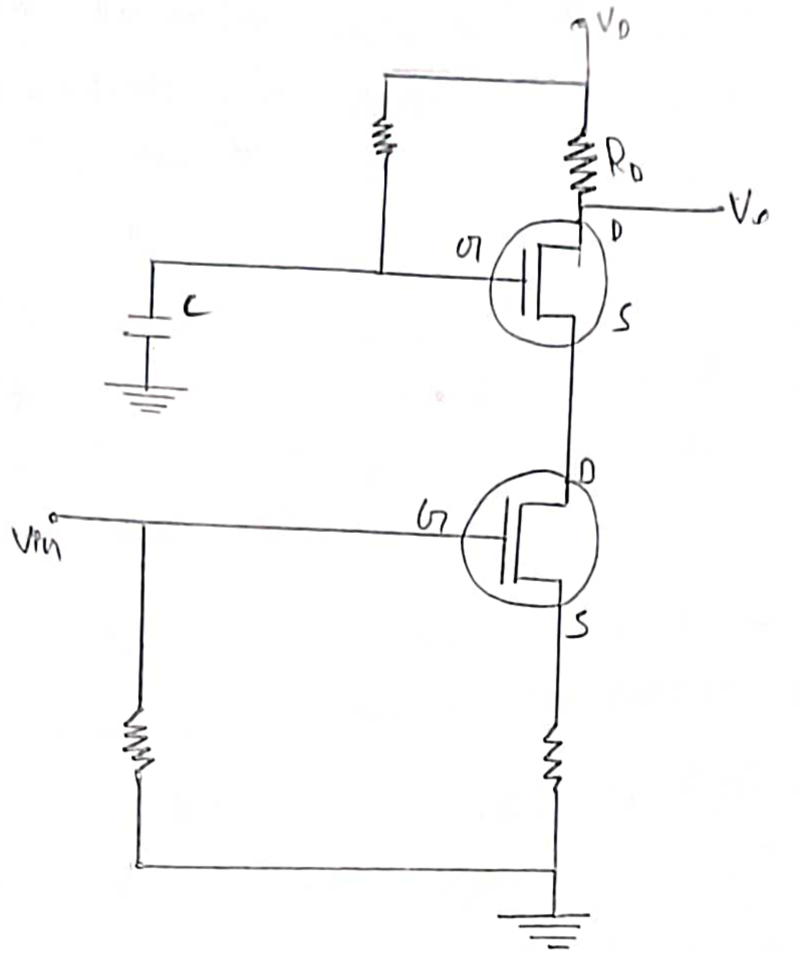
$$A_2 = \frac{R_{C2} \parallel R_L}{r_e}$$

Care must be taken while selecting A_2 and A_1. If A_1 is large the input to the second stage will become too high. The gain of the first stage can be controlled by a negative feedback in series with emitter, this is achieved by unbypassed resistor Re.

Effects of Cascading is that, single stage amplifier is not able to provide enough power and fulfil all the requirement of an ideal amplifier, so multistage amplifier is required. In multistage amplifier, a number of single amplifiers are connected in cascade arrangement ie, output of first stage is connected to input of second stage, hence increasing voltage and current gain.

20) With circuit schematic explain the working of Cascade amplifier. How wide bandwidth is obtained in Cascade amplifier?

A) A cascade amplifier is a double staged circuit with a transconductance amplifier that follows the buffer amplifier liber



If an amplifier comprises of BJT, then the input stage is C-E configuration that feeds to the common base at which output is collected. This type of amplifiers is known as cascade amplifier.

The input signal is applied at the terminal gate at initial stage. The second stage that is output stage that is driven from the output of the ~~individual stage~~ initial stage's configuration, common drain. The final output is collected from the drain terminal at which the resistor R_D is connected. The gate of the FET at the second stage is grounded. So the values of the source voltage of the second stage FET has remained equivalent to the drain voltage of the first stage FET.

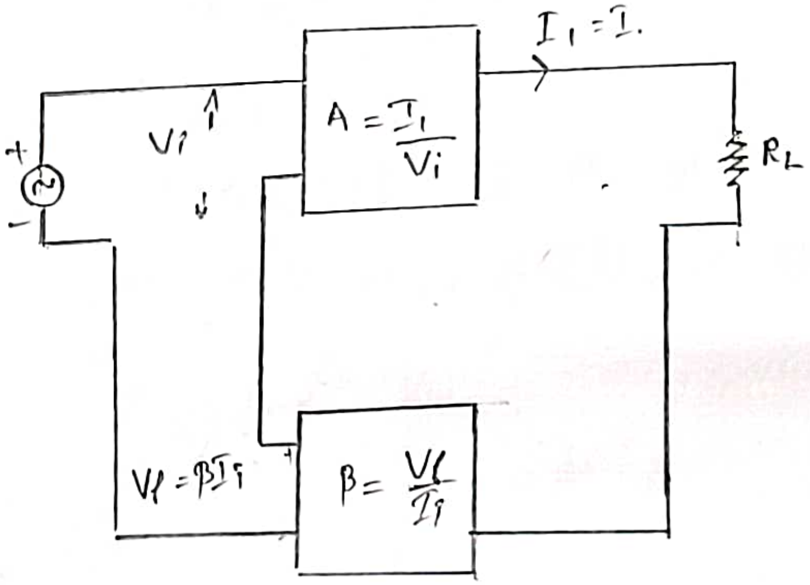
FET at the second stage offers a low resistance path. The gain of the FET as the front page is reduced which indirectly reduces miller effect. Hence increase band width. The overall gain does not get affected because it is compensated. by the FET in second stage.

As the voltage at the source and drain of the first stage FET, gate and the source terminals of second stage FET is almost constant. Hence there is nothing for feed trade. These leads to isolation and the condition is called miller effect.

High BandWidth: A cascade amplifier use 2 mismatched stage in order to minimize the reverse voltage feed. No negative feedback technique is useful at high frequencies. Next because of CB stage. the miller capacitance of transistor is minimised by limiting voltage gain of amplifier to 1. Avoiding the miller capacitance boosting is biggest Advantage.

30) Derive expression for voltage gain, input impedence and output Impedance of current series and current shunt amplifiers with feedback.

i) Current series feedback:-



i) Input impedence of current series feedback

$$R_{if} = \frac{V_s}{I_i}$$

we know $V_s = V_i + V_f$

$$\Rightarrow R_{if} = \frac{V_i + V_f}{I_i}$$

$V_f = \beta V_o \Rightarrow R_{if} = \frac{V_i + \beta V_o}{I_i} = \frac{V_i}{I_i}\left(1 + \frac{\beta V_o}{V_i}\right)$

$\frac{V_o}{V_i} = A \Rightarrow R_{if} = (\beta A + 1)\frac{V_i}{I_i}$

$\frac{V_i}{I_1} = R_1 \Rightarrow R_{if} = R_1(1 + \beta A)$

ii) Output impedence of current series amplifier and output pedance of current-shunt amplifier with feed back

Total current, $I = \frac{V}{R_o} + AI_i$

$$= V = (I - AI)R_o \quad -(1)$$

Source current $I_s = I_1 + I_f$

$I_s = 0$

$I_1 = I_f$

$I_f = \beta I_o$

$I_i = -I_f$

$\Rightarrow I_i = -\beta I_o \Rightarrow I_i = -\beta I \rightarrow (2)$

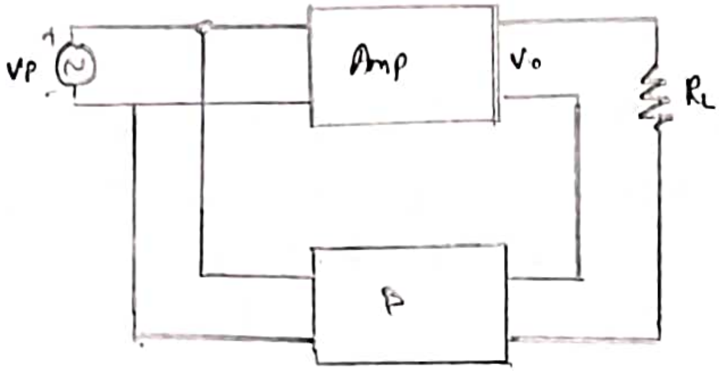
$\Rightarrow V_s = (I + A\beta I)R_o \rightarrow (3)$

$\therefore \quad R_{of} = \frac{V}{I}$

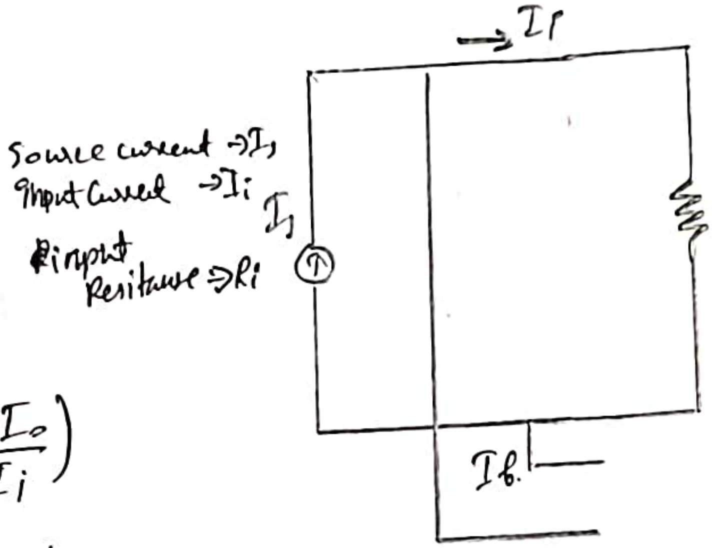
$$= \frac{(I + A\beta I)R}{I} = \frac{I(1 + A\beta)R_o}{I}$$

$$R_{of} = (1 + A\beta)R_o$$

2) Current shunt feedback:



iii) Current shunt feedback:



$$R_{if} = \frac{V_i}{I_B}$$

$$I_s = I_i + I_f$$

$$I_f = \beta I_o$$

$$\Rightarrow R_{if} = \frac{V_i}{I_i + \beta I_o} = \frac{V_i}{I_i\left(1 + \frac{\beta I_o}{I_i}\right)}$$

$$I_f = \beta I_o$$

$$\text{Gain} = \frac{I_o}{I_i} = A \Rightarrow R_{if} = \frac{V_i}{I_i(1 + \beta A)}$$

$$\therefore \frac{V_i}{I_i} = R_i \Rightarrow R_{if} = \frac{R_i}{(1 + A\beta)}$$

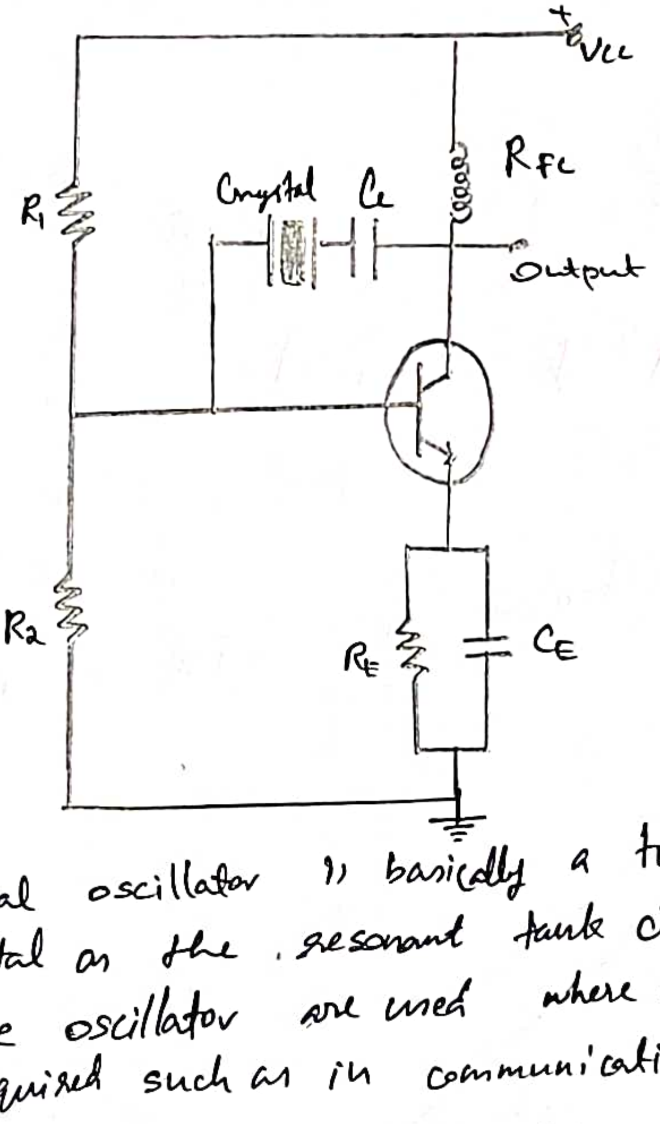
* Gain with feedback of current series $A_f = I_o/V_i$
* Gain with feedback for current shunt $A_f = I_o/I_s$

Q. Define piezo electric effect, with circuit schematic explain the working principle of crystal oscillator

piezo electric effect: piezo electric effect is the ability of certain material to generate an electric charge in response to applied stress.

when peizoelectric crystal is placed under mecham...
ss a shelving of positive and negative charge centre in
the material takes places, which results in an external field
when reversed, an outer electrical field either streches or compre-
sses the piezo electric material.

Crystal oscillator:--



- Crystal oscillator is basically a tuned circuit using piezo electric crystal as the resonant tank circuit.
- These oscillator are used where as higher frequency stability is required such as in communication transmitters and reciever.
- piezoelectric crystal exhibit piezo electric property:
the ability to transform mechanical deformation into eletrical charge, and vise versa
- If a piezo eletric material is squeezed it develops a voltage and if a voltage is applied across

If a machanical dimension occurs

- Crystal oscillator operate on the principle of Inverse piezo electric effect, in which alternating voltage is applied causing it to vibrate at its natural frequence.

- It's there vibration which eventually get converted into oscillation,

- There oscillators are ussually make of quartz crystall.