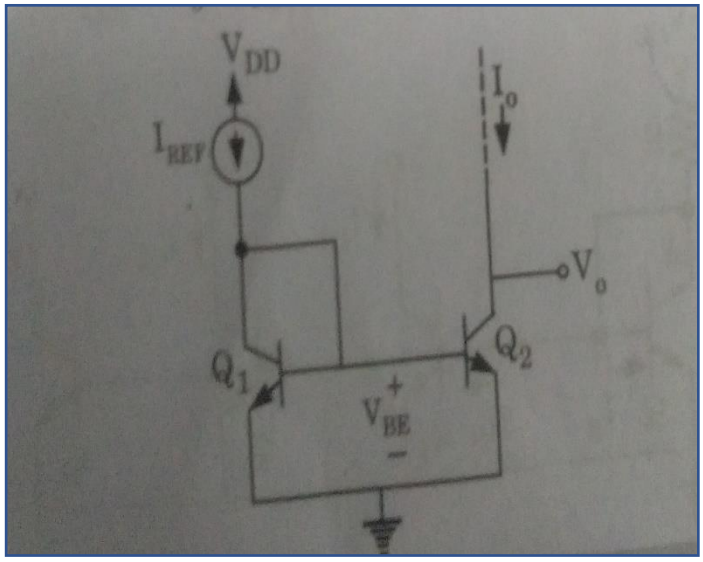
UNIT-4 >>CURRENT MIRROR AND OP-AMP DESIGN

SUBJECT-ANALOG CIRCUIT

LECTURE-1>>CURRENT MIRROR

BJT CURRENT MIRROR

The basic BJT current mirror is shown in fig



Consider β is high and neglect base current I R_{EF} is passed through Q_1 and the corresponding voltage is V_{BE}. V_{BE} is applied voltage between base and emitter of Q_2.

Now, Q_2 is matched to Q_1, i.e. same relative area of emitter-base function and having equal collector current.

Here, Q_2 is in active mode until V_o is 0.3v or higher than emitter voltage.

For obtaining the current transfer ratio, it is required to consider m times relative area of emitter-base junction (EBJ).

$I_o = m\ I_{REF}$

The current transfer ratio,

$I_O \div I_{REF} = I_{s2} \div I_{s1}$ = Area of EBJ $OFQ_2 \div$ Area of EBJ OFQ_1

From the node equation at collector of Q_1,

$I_{REF} = I_C = 2I_C/\beta$

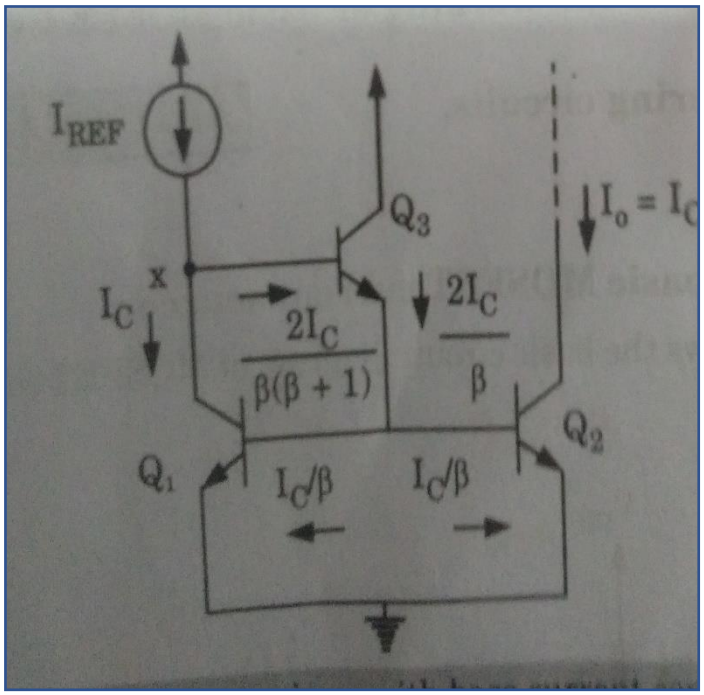
Since $I_o = I_C$

$I_O \div I_{REF} = I_C/I_C(1+2I_C/\beta)$

BASE CURRENT MIRROR

A bipolar current mirror with a current transfer ratio is less dependent on β than that of simple current mirror.

This reduces dependency on β and is achieved by using transistor Q_3. The Q_3 supplies the base current to the Q_1 and Q_2.



The sum of base currents divided by (β_3) resulting in much smaller error current, that has to be supplied by I_{REF}.

Let us assume Q and Q are matched and having equal collector current.

A node equation at node x gives

$I_{REF} = I_C [1+2/\beta(\beta+1)]$

As, $I_o = I_C$

The current transfer ratio of the mirror will be

$I_o/I_{REF} = 2/1+\beta(\beta+1) = 1/1+2/\beta^2$ _____ eq.3

Eq.3 shows that the error due to finite β has been reduced from $2/\beta$ to $2/\beta^2$

However, the output resistance(R_0) remains approximately equal to that of simple mirror.

IF I_{REF} is not present, then we connect node x to the power supply V_{cc} trough resistor R, then

$I_{REF=}Vcc\text{-}V_{BE1}\text{-}V_{BE3}/R$

CHARACTERISTICS OF CURRENT MIRROR: -

- More accurate current transfer ratio.
- Highly output resistance.