Problems on Feedback in Amplifiers

7.1

A = Basic Amplifier Gain = 10^5

A_f = Gain with feedback = 100

(i) what is feedback factor β ?

(ii) If A falls to 10^3, what is new A_f ?

$$A_f = \frac{A}{1+A\beta} = \frac{10^5}{1+10^5 \cdot \beta} = 10^2$$

Find β.

$$\frac{100000}{1+100000\beta} = 100$$

$$\therefore \quad 1+100000\beta = 1000$$

$$100000\beta = 999$$

$$\therefore \quad \beta = 9.99 \times 10^{-3}$$

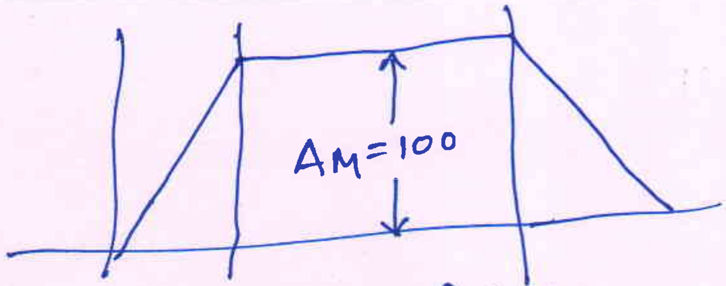
$$A_f \text{ at } A = 1000 = \frac{A}{1+A\beta} = \frac{1000}{1+1000 \times 9.99 \times 10^{-3}}$$

$$= \frac{1000}{1+0.999 \times 10} = \frac{1000}{\cancel{5.999}\ \cancel{1.999}\ 10.999} = 90.99$$

$$\frac{\Delta A_f}{A_f} = \frac{90.99-100}{100} = -9\%$$ for a very large change in A.

7.14

②



Before F/B = 100.

BW = 10 kHz − 100 Hz = 9900 Hz.

Feedback = 10

Midband gain after negative feedback is applied.

What are f_{Lf}' and f_{Hf} after

$$A_{Mf} = \frac{A_M}{1 + A_M \cdot \beta}$$

$$\omega_{Hf} = \omega_H (1 + A_M \beta)$$ — high freq. extended

$$\omega_{Lf} = \frac{\omega_L}{(1 + A_M \beta)}$$ — lower cutoff freq. reduced to extend BW.

$$10 = \frac{100}{1 + 100 \cdot \beta}$$

$$1 + 100 \cdot \beta = 10$$

$$100 \cdot \beta = 9 \qquad \therefore \beta = \frac{9}{100}.$$

$$D = 1 + A\beta = \frac{100}{10} = 10.$$

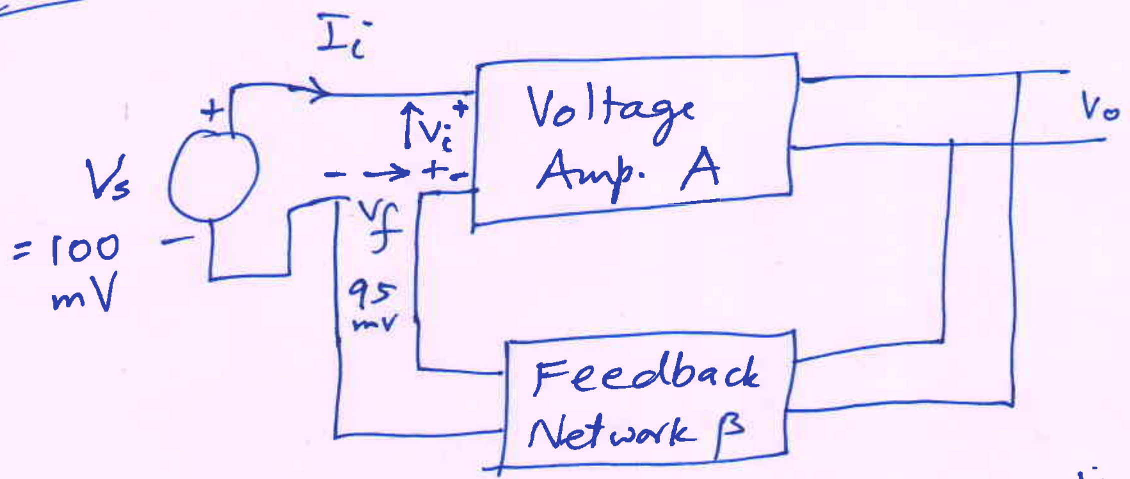
$$\therefore \omega_{Hf} = 10\text{ kHz} \times D = 10 \times 10 = 100\text{ kHz}$$

$$\omega_{Lf} = \frac{100\text{ Hz}}{D} = \frac{100}{10} = 10\text{ Hz}.$$

$= \underline{100000 - 10\text{ Hz}}$

Q:7.21

SERIES – SHUNT F/B



$V_s = 100\,mV$; $V_f = 95\,mV$; $V_o = 10\,V$

What are values of A & β ?

$$V_i = V_s - V_f = 100 - 95\,mV = 5\,mV$$

$$V_o = 10\,V = 10000\,mV$$

$$\therefore \text{Voltage Gain } A = \frac{V_o}{V_i} = \frac{10000\,mV}{5\,mV} = \boxed{2000\ V/V}$$

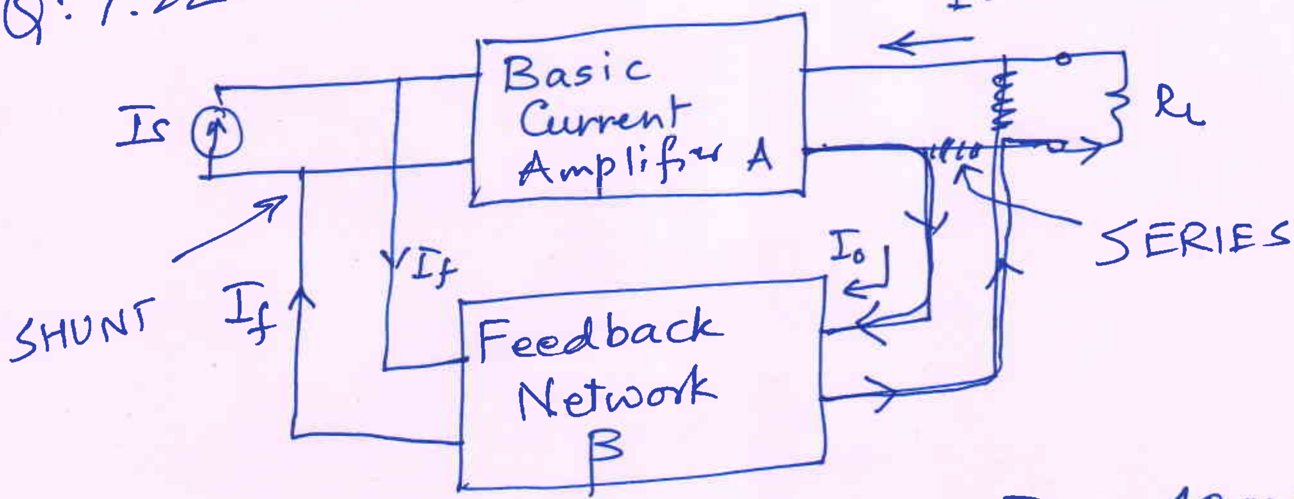
$$\beta = \frac{V_f}{V_o} = \frac{95\,mV}{10000\,mV} = \boxed{0.0095\ V/V}$$

X

Q: 7.22

Next Page

Q: 7.22 SHUNT-SERIES



$I_s = 100\mu A \quad I_f = 95\mu A \quad I_o = 10\,mA$

Find A & β and mention their units

$$\text{Current Gain of Amplifier} = \frac{\text{Output Current}}{\text{Input Current}}$$

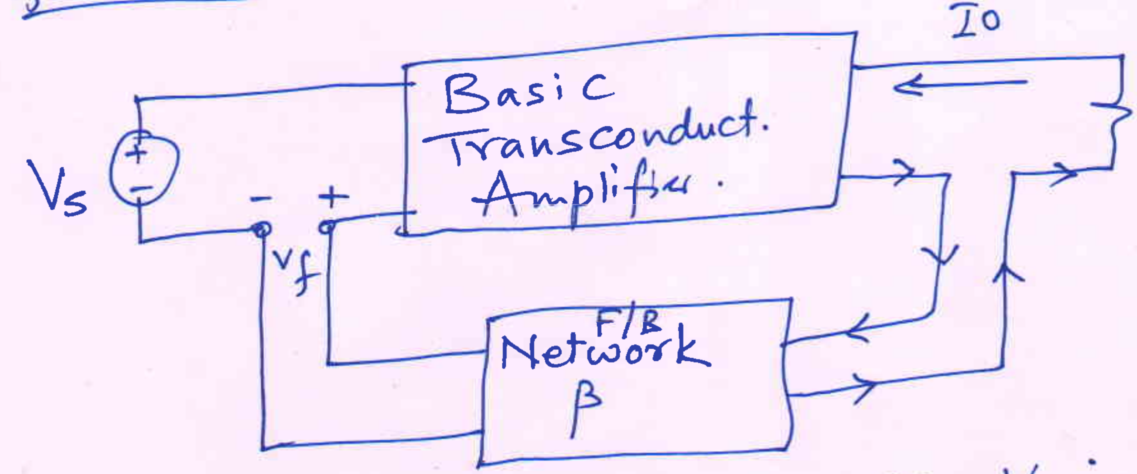
$$= \frac{I_o}{I_s - I_f} = \frac{10\,mA}{(100-95)\mu A}$$

$$= \frac{10{,}000\,\mu A}{5\,\mu A} = \boxed{2000\ \mu A/\mu A}$$

$$\beta = \frac{I_f}{\cancel{I_s}\, I_o} = \frac{\cancel{10000\,\mu A}\ 95\,\mu A}{10000\,\mu A}$$

$$= \frac{0.095\,mA}{10\,mA} = \boxed{0.0095\ mA/mA}$$

Q: 7.24



$V_s = 100\,mV$; $V_f = 95\,mV$; $I_o = 10\,mA$

Find A & β and their units.

$$V_i = V_s - V_f = 100 - 95 = 5\,mV$$

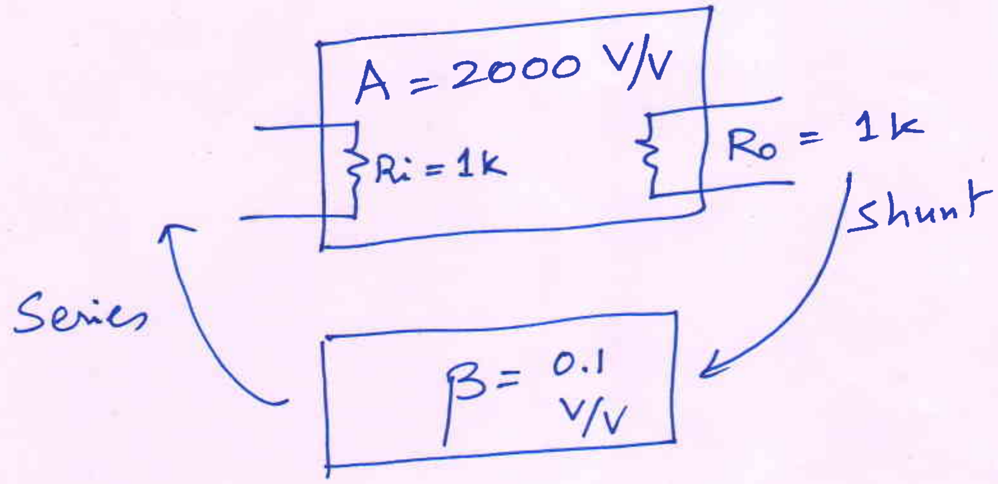
$$A = \text{Transconductance} = \frac{I_o}{V_i} = \frac{10\,mA}{5\,mV} = 2\,℧$$

$= 2$ ~~volts~~ mhos

$$\boxed{= 2 \text{ Amps / Volts} \quad = 2000\ m℧}$$

$$\beta = \frac{V_f}{I_o} = \frac{95\,mV}{10\,mA} = \boxed{9.5 \text{ ohms}}$$

7:27 Series Shunt F/B Amplifier



Find A_f, R_{if} and R_{of}.

$$D = 1 + A\beta = 1 + 2000 \times 0.1 = 1 + 200$$
$$= 201$$

$$R_{if} = R_i \cdot D = 1K \times 201 = \boxed{201K}$$

$$R_{of} = R_o / D = 1K/201 \approx 5\,\Omega$$

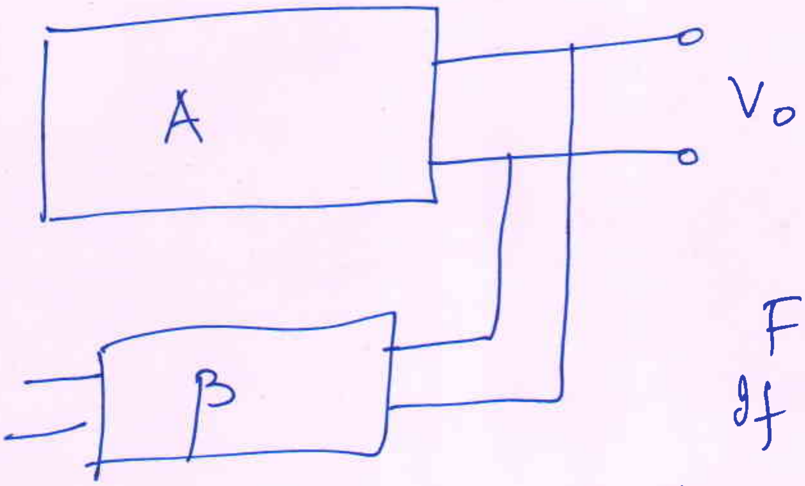
$$A_f = A/D = 2000/201 = \boxed{9.95 \text{ V/V}}$$

Gain A_f from approx. formula for validating

$$A_{f\,approx} = \frac{1}{\beta} = \frac{1}{0.1} = 10 \text{ V/V}.$$

The approx. value is pretty close to calculated gain 9.95 ∴ our calculations are right!

Q:7:28 In Feedback loop, Output voltage is Sampled.



Find $A\beta$.
If $R_{of} = 100$, find R_o.

Ratio of R_o after feedback / R_o before feedback $= \frac{1}{80}$

Note that since we are sampling output VOLTAGE, β network will tap 2 points at V_o or $O-O'$, in shunt with R_L or output. This will LOWER output resistance AFTER feedback

$$\therefore \frac{R_{of}}{R_o} = \frac{1}{80} =$$

$$\because R_{of} = \frac{R_o}{D} \quad \therefore \boxed{D = 80.}$$

$$D = 1 + A\beta = 80 \quad \therefore \boxed{A\beta = 79 = \text{Loop Gain}}$$

$$R_o = R_{of} \cdot D = 100 \times 80 = \boxed{8K}$$