REPASO EXAMEN 2

INEL 4202 - Primer semestre 2012-2013

TEMAS

- Análisis de amplificadores para obtener A_f, R_{if} y R_{of}
- Estabilidad
- Osciladores senoidales

Análisis de amplificadores para obtener A_f, R_{if} y R_{of}

TABLE 8.1 Summary of Relationships for the Four Feedback Amplifier Topologies

Feedback Amplifier	x_i	x_o	x_f	x_s	A	β	A_f	Source Form	Loading of Feedback Network Is Obtained		To Find β, Apply to Port 2 of Feedback Network	Z_{if}	Z_{of}	Refer to Figs.
									At Input	At Output				
Series–shunt (voltage amplifier)	V_i	V_o	V_f	V_s	$\frac{V_o}{V_i}$	$\frac{V_f}{V_o}$	$\frac{V_o}{V_s}$	Thévenin	By short-circuiting port 2 of feedback network	By open-circuiting port 1 of feedback network	a voltage, and find the open-circuit voltage at port 1	$Z_i(1+A\beta)$	$\frac{Z_o}{1+A\beta}$	8.4(a) 8.8 8.10 8.11
Shunt–series (current amplifier)	I_i	I_o	I_f	I_s	$\frac{I_o}{I_i}$	$\frac{I_f}{I_o}$	$\frac{I_o}{I_s}$	Norton	By open-circuiting port 2 of feedback network	By short-circuiting port 1 of feedback network	a current, and find the short-circuit current at port 1	$\frac{Z_i}{1+A\beta}$	$Z_o(1+A\beta)$	8.4(b) 8.22 8.23 8.24
Series–series (transconductance amplifier)	V_i	I_o	V_f	V_s	$\frac{I_o}{V_i}$	$\frac{V_f}{I_o}$	$\frac{I_o}{V_s}$	Thévenin	By open-circuiting port 2 of feedback network	By open-circuiting port 1 of feedback network	a current, and find the open-circuit voltage at port 1	$Z_i(1+A\beta)$	$Z_o(1+A\beta)$	8.4(c) 8.13 8.15 8.16
Shunt–shunt (transresistance amplifier)	I_i	V_o	I_f	I_s	$\frac{V_o}{I_i}$	$\frac{I_f}{V_o}$	$\frac{V_o}{I_s}$	Norton	By short-circuiting port 2 of feedback network	By short-circuiting port 1 of feedback network	a voltage, and find the short-circuit current at port 1	$\frac{Z_i}{1+A\beta}$	$\frac{Z_o}{1+A\beta}$	8.4(d) 8.18 8.19 8.20

Stability

Basics

- Basic feedback equation:

$$A_f(s) = \frac{a(s)}{1+\beta(s)a(s)}$$

  Thus, feedback moves the poles of the amplifier's transfer function.

- Poles of A_f are roots of $1+\beta a$. Thus, feedback moves the poles of the amplifier's transfer function.

- The idea is to determine information about the stability of A_f from the loop gain $T(s) = \beta(s)a(s)$.

Nyquist Theorem

Let ω_{180° be the frequency at which the loop gain's phase angle is -180°. If

$$| T(j\omega_{180^\circ}) | = | \beta(j\omega_{180^\circ}) A(j\omega_{180^\circ}) | > 1$$

then the amplifier is unstable. Otherwise, it is stable.

Nyquist theorem allows us to answer questions about the stability of A_f by analyzing the loop gain βA.

Phase and Gain Margin

- Gain margin: decibels below zero of $| T(j\omega_{180^\circ}) |$.

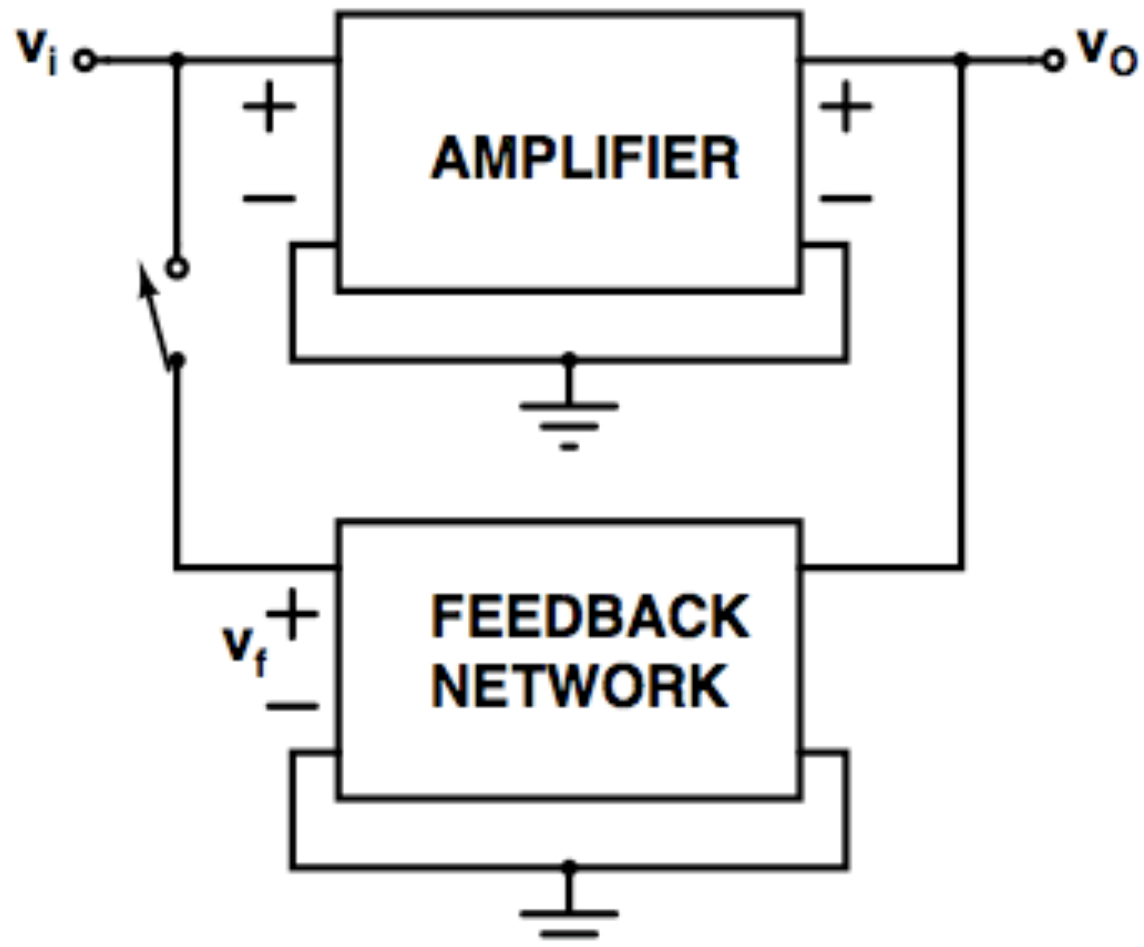
- Phase margin: degrees above -180° at the frequency ω_{0dB} at which $| T(j\omega_{0dB}) |= 1$, or 0 db.

$$\phi_m = 180 + \angle T(j\omega_{0dB})$$

  Note that $\angle T(j\omega_{0dB})$ is usually negative.

- The amplifier is unstable if the gain and phase margins are negative. If the margins are positive or zero the amplifier is *stable* or *marginally stable*, respectively.

1 Barkhousen Criterion



If the loop gain $L = A(\omega)\beta(\omega)$ is real and larger than one at a frequency ω_0, the circuit will produce a sinusoidal output voltage with frequency ω_0.

$$\frac{v_f}{v_i} = A(\omega_0)\beta(\omega_0) = M(\omega_0)\angle\phi(\omega_0) = +1$$

This means that the magnitude $M(\omega_0)$ must be unity and the phase angle $\angle\phi(\omega_0) = 0°$.

Strategy:

- find loop gain $L = A(\omega)\beta(\omega)$
- find frequency ω_0 at which the loop gain is real; the imaginary part is zero
- determine the amplifier gain required to make the loop gain larger than 1
- the criterion must be satisfied at a single, well defined ω_0
- the amplifier gain A will depend on the input impedance of the feedback network, unless the amplifier's output impedance is zero (i.e. op amps)