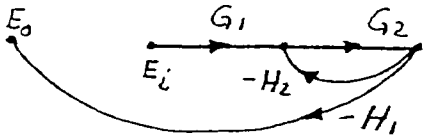
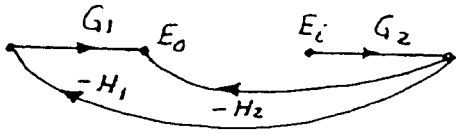
9.1.(a)



$-(\text{open-loop transfer function}) = \dfrac{G_1 G_2 H_1}{1 + H_2 G_2}$

(b)



$-(\text{o.l.t.f.}) = G_2 H_2 + G_1 G_2 H_1$

9.2.(a) G.M. (at $\omega \approx 4$ rad/s) $\approx$ 8dB

ϕ_m (at $\omega \approx 2.7$ rad/s) $\approx 30°$

(b) $\angle G(j\omega_1) = -180° + 45° + 5° = -130°$

$\therefore \omega_1 \approx 2$, $\therefore \omega_1 = 2$, $|G(j\omega_1)| \cong 1.468$

$\omega_0 = (0.1)(2) = 0.2$

$\omega_p = \dfrac{\omega_0}{|G(j\omega_1)|} = \dfrac{0.2}{1.468} = 0.136$

$\therefore G_c(s) = \dfrac{1 + s/0.2}{1 + s/0.136} = \dfrac{0.685 + 0.136}{s + 0.136}$

(c) (i) $g_m = 3.59$

$\phi_m = 47.9°$

(ii) poles at: $-6.4, -0.189, -0.7683 \pm j\,2.48$

(d) $\tau_1 = \frac{1}{6.4} = 0.156$ s; $\tau_2 = \frac{1}{0.189} = 5.29$ s, $\tau_3 = \frac{1}{0.7683} = 1.30$ s