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2.15 解：信号流图中共4个回路、增益为：

$L_1 = -G_1(s)H_3(s)$　　$L_2 = -G_1(s)G_2(s)H_2(s)$

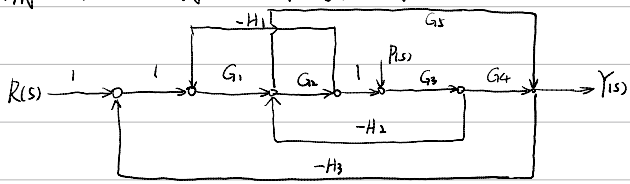
$L_3 = -G_1(s)G_2(s)H_1(s)$　　$L_4 = -\frac{k}{s}G_1(s)G_2(s)$

由于回路两两接触，前向通路为1　$P_1 = \frac{k}{s}G_1(s)G_2(s)$

$\Delta_1 = 1$　由梅森公式 $G(s) = \frac{Y(s)}{R(s)} = \frac{P_1\Delta_1}{\Delta}$

故 $G(s) = \frac{kG_1(s)G_2(s)}{kG_1(s)G_2(s)+s[1+H_3(s)G_1(s)+H_2(s)G_1(s)G_2(s)+H_1(s)G_1(s)G_2(s)]}$

2.17 解：将方框图转化为信号流图



传递函数 $\frac{Y(s)}{R(s)}$、$\frac{Y(s)}{P(s)}$

① $\frac{Y(s)}{R(s)}$ 将 $P(s)$ 置0　前向通路2条，增益为 $P_1 = G_1G_2G_3G_4$、$P_2 = G_1G_5$

回路共4条 $L_1 = -G_1H_1G_2$、$L_2 = -H_2G_2G_3$、$L_3 = -G_1G_2G_3H_3G_4$、$L_4 = -G_1H_3G_5$

$\Delta = 1 - \sum L_a + \sum L_bL_c - \cdots\cdots$　无两两互不接触回路

所有回路均和前向通路相连　$\Delta_1 = 1$　$\Delta_2 = 1$

综上：$\Delta = 1 + G_1H_1G_2 + G_2H_2G_3 + G_1G_2G_3H_3G_4 + G_1H_3G_5$

由梅森公式 $\frac{Y(s)}{R(s)} = \frac{G_1G_2G_3G_4 + G_1G_5}{1 + G_1H_1G_2 + G_2H_2G_3 + G_1G_2G_3H_3G_4 + G_1H_3G_5}$

② 将 $R(s)$ 置0　前向通路共3条

增益 $P_1 = G_3G_4$　$P_2 = -H_2G_3G_5$　$P_3 = -G_3G_4H_3G_1G_5$

回路共3条 $L_1 = -G_2H_2G_3$　$L_2 = -G_1H_1G_2$　$L_3 = -G_1G_2G_3H_3G_4$

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$\Delta = 1 - \sum L_a + \sum L_b L_c - \cdots$ 无两两不接触回路

且所有回路和前向通路接触 $\Delta_1 = \Delta_2 = \Delta_3 = 1$

由梅森公式 $\frac{Y(s)}{P(s)} = \frac{G_3 G_4 (1 - G_1 H_3 G_5) - H_2 G_3 G_5}{1 + G_2 H_2 G_1 + G_1 H_1 G_2 + G_1 G_2 G_3 H_3 G_4}$

当分母为0时 无影响 即 $G_3 G_4 (1 - G_1 H_3 G_5) = H_2 G_3 G_5$

∴ 当 $G_4 (1 - G_1 H_3 G_5) = H_2 G_5$ 时 $Y(s)$ 不受 $P(s)$ 的影响。