ME451: Control Theory (Radcliffe)
Fall 2004 Root Locus Design Quiz **Name**

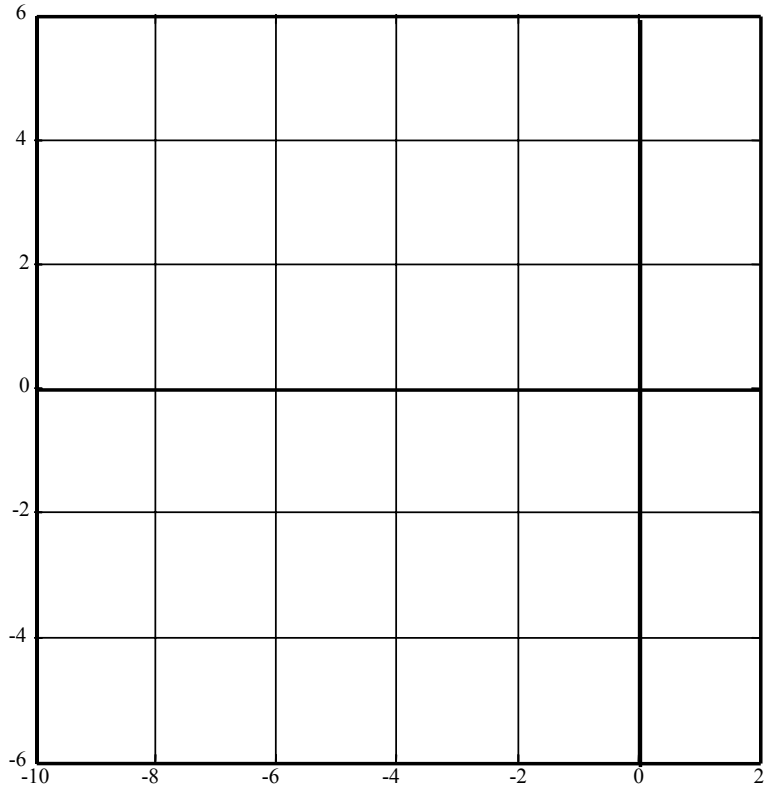
For a system with Transfer Function $G_P(s)=$

(See below for a list of Transfer Functions)

Use Root locus to design a PI controller

$$G_C(s) = K_P + \frac{K_I}{s} = \frac{K_P s + K_I}{s} = K_P\left[\frac{s + \left(K_I / K_P\right)}{s}\right]$$

that has zero closed loop error and closed-loop time constant and damping ratios of approximately (see below for list of time constants).



Some example systems…

Plant Transfer Function	Desired CL time constant	Desired CL damping ratio
$G_P(s) = \frac{2}{4s+1} = \frac{0.5}{s+0.25}$	$\tau = 1$ sec	$\varsigma = 0.7$
$G_P(s) = \frac{0.25}{0.25s+1} = \frac{1}{s+4}$	$\tau = 1$ sec	$\varsigma = 1.0$
$G_P(s) = \frac{0.25}{0.25s+1} = \frac{1}{s+4}$	$\tau = 0.25$ sec	$\varsigma = 0.7$

Hints:

1) Write the system open-loop transfer function with K_P factored out

2) Place the open-loop poles and zeros on the root locus. Note you will need to place close loop zero $s + \left(K_I / K_P\right)$ at some appropriate location. There are usually many possible locations that will work.

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