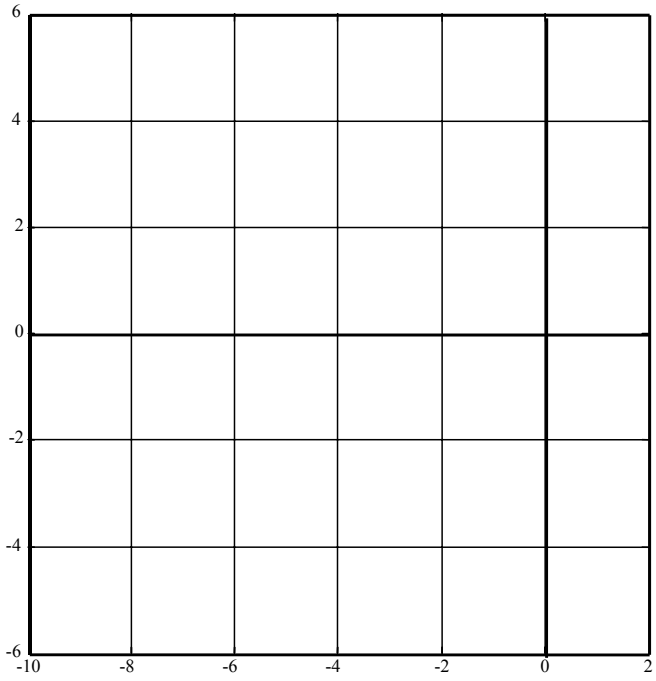
ME451: Control Theory (Radcliffe)
Fall 2004 Root Locus PD Control Design Quiz **Name**

For a system with Transfer Function $G_P(s) =$ (See Below),
Use Root locus to design a PD controller with low pass filter (Rate Feedback, Section 7.6.1 in text)

$$G_C(s) = \frac{K_P + K_D s}{Ts+1} = \left[\frac{K_D s + K_P}{Ts+1}\right] = K_D\left[\frac{\left(s + \left(K_P/K_D\right)\right)}{T\left(s+1/T\right)}\right]$$

that has the closed-loop damping ratio and closed-loop time constant specified (See table).



Hints:
1) Write the system open-loop transfer function with K_D factored out
2) Place the open-loop poles and zeros on the root locus. Note you will need to place the controller pole and zero at appropriate locations. There are sometimes many possible locations that will work.

Plant Transfer Function	Time Constant	damping ratio
$G_P(s) = \frac{5}{s^2+16}$, $T = 0.025\,\text{sec}$	$\tau = 0.25$ sec	$\varsigma \cong 0.7$
$G_P(s) = \frac{5}{s^2+16}$, $T = 0.025\,\text{sec}$	$\tau = 0.25$ sec	$\varsigma \cong 1.$
$G_P(s) = \frac{5}{s^2+16}$, $T = 0.01\,\text{sec}$	$\tau = 0.1$ sec	$\varsigma \cong 0.7$

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