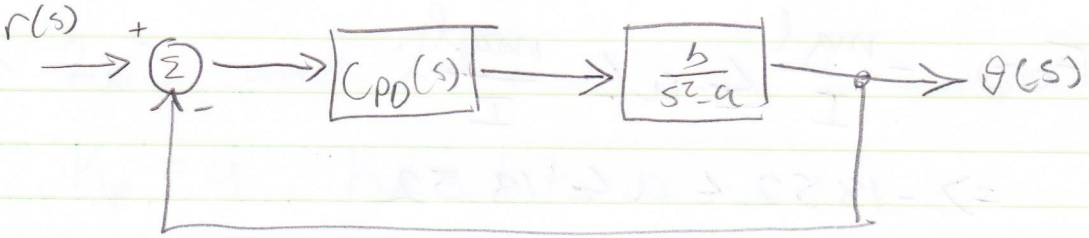
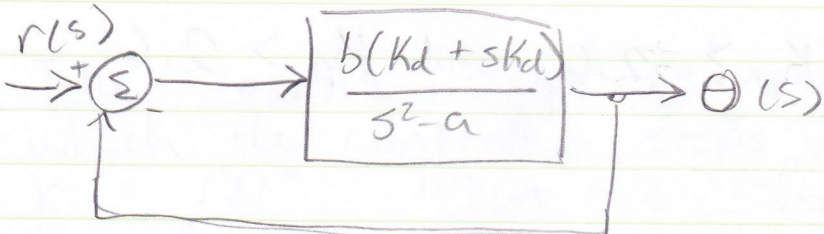
2a)



$$C_{PD} = K_p + sK_d$$



$$\frac{\theta(s)}{r(s)} = \frac{\frac{b(K_p+sK_d)}{s^2-a}}{1+\frac{b(K_p+sK_d)}{s^2-a}} = \frac{b(K_p+sK_d)}{s^2-a+b(K_p+sK_d)}$$

$$\frac{\theta(s)}{r(s)} \quad \frac{bK_d s + bK_d}{s^2 + bK_p s + (bK_p - a)}$$

b) Routh Array

s^2	1	$bK_p - a$
s^1	bK_d	
s^0	$bK_p - a$	

Stability conditions

$bK_d > 0$

$K_p b - a > 0$

and $K_p b > a$

$K_p > \frac{a}{b}$