Tutorial - 1

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Q1

$$P_1 = s^5 + 2s^4 + 7s^3 + 10s^2 + 7s + 1$$

Routh table:-

s^5	1	7	7
s^4	2	10	1
s^3	2	13/2	0
s^2	3.5	1	0
s^1	5.1428	0	0
s^0	1		

$\Rightarrow$ no change in sign $\Rightarrow$ stable

With K:

$$P_K(s) = s^5 + 2s^4 + 7s^3 + 10s^2 + 7s + 1 + K$$

s^5	1	7	7
s^4	2	10	$1+K$
s^3	2	$\frac{12-K}{2}$	0
s^2	$\frac{K+7}{2}$	$1+K$	0
s^1	$\frac{K^2-2K+8}{2(K+7)}$	0	0
s^0	$1+K$		

$K+7>0 \quad K+1>0$

$K>-7 \quad K>-1$

$K^2+2K-83<0$

$-\sqrt{21} < K < 2\sqrt{21} - 1$

$\Rightarrow \boxed{-1 < K < 8.165}$

Q.2:

=> System is stable

=> Poles of system are in LHS. Therefore, it is stable.
The step response confirms this rise in output and
then settles to a value.

=> Added a zero at -2.
Stability improved (closed loop poles moved left)