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Control Systems

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Contents

***Abstract*—This manual is an introduction to control systems based on GATE problems.Links to sample Python codes are available in the text.**

Download python codes using

```
svn co https://github.com/gadepall/school/trunk/
    control/codes
```

1 Routh Hurwitz Criterion

1.1. Consider a unity feedback system as shown in the figure,shown with an integral compensator $\frac{k}{s}$ and open-loop transfer function

$$G(s) = \frac{1}{s^2+3s+2} \tag{1.1.1}$$

where $k > 0$. Find the positive value of k for which there are two poles of unity feedback system on the $\jmath\omega$ axis.

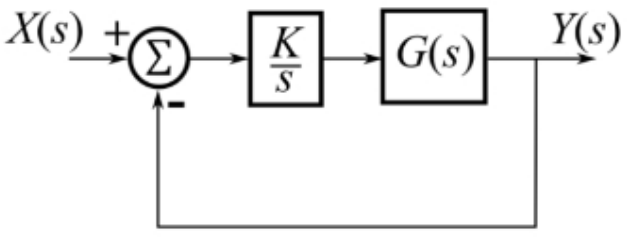

Fig. 1.1

Solution: The open loop transfer function

$$G(s) = \frac{1}{s^2+3s+2} \tag{1.1.2}$$

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Hence,

$$H(s) = \frac{Y(s)}{X(s)} = \frac{G(s)k/s}{1+G(s)k/s} \tag{1.1.3}$$

$$= \frac{k}{1+ks(s^2+3s+2)} \tag{1.1.4}$$

The poles of $H(s)$ are obtained from

$$s^3+3s^2+2s+k = 0 \tag{1.1.5}$$

The corresponding Routh array is given by

$$\begin{vmatrix} s^3 & 1 & 2 \\ s^2 & 3 & k \\ s^1 & \frac{6-k}{3} & 0 \\ s^0 & k & 0 \end{vmatrix} \tag{1.1.6}$$

2 Bode Plot

3 Compensators

4 Nyquist Plot