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
```

0.0.1. Fig. 0.0.1.1 shows the Bode magnitude and phase plots of

$$G(s) = \frac{n_0}{s^3 + d_2 s^2 + d_1 s + d} \tag{0.0.1.1}$$

Find $\left|G\left(\jmath\omega_{pc}\right)\right|$.

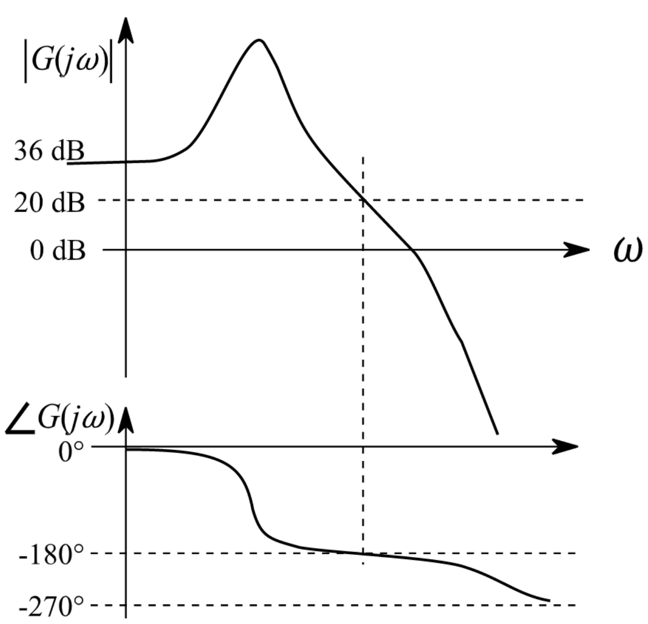

Fig. 0.0.1.1

Solution: From Fig. 0.0.1.1,

$$\angle G\left(\jmath\omega_{pc}\right) = 180° \tag{0.0.1.2}$$

$$\implies 20\log\left|G\left(\jmath\omega_{pc}\right)\right| = 20 \tag{0.0.1.3}$$

0.0.2. Consider the negative unity feedback configuration with gain k in the feed forward path as shown in Fig. 0.0.2.1. Find the condition for the closed loop system to be stable.

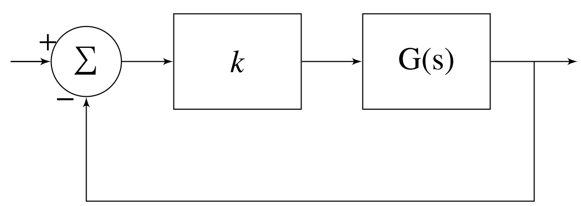

Fig. 0.0.2.1

Solution: The open loop gain for the system in Fig. 0.0.2.1 is

$$G_1(s) = kG(s) \tag{0.0.2.1}$$

$$\implies \angle G_1\left(\jmath\omega_{pc}\right) = \angle G\left(\jmath\omega_{pc}\right) \tag{0.0.2.2}$$

$$= 180° \quad \text{and} \tag{0.0.2.3}$$

$$20\log\left|G_1\left(\jmath\omega_{pc}\right)\right| = 20\log|k| + 20\log\left|G\left(\jmath\omega_{pc}\right)\right| \tag{0.0.2.4}$$

$$= 20\left(1 + \log|k|\right) \tag{0.0.2.5}$$

from (0.0.1.3). From (**??**) and (0.0.2.5), the GM of $G_1(s)$ is

$$-20\log\left|G_1\left(\jmath\omega_{pc}\right)\right| = -20\left(1 + \log|k|\right) \tag{0.0.2.6}$$

For stability, $GM > 0$

$$\implies -20\left(1 + \log|k|\right) > 0 \tag{0.0.2.7}$$

$$\implies |k| < 0.1 \tag{0.0.2.8}$$

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