Control Systems

G V V Sharma*

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 Feedback Circuits

1.1. For the feedback voltage amplifier fig.1.1 and specs in Table 1.1. If $R_1 = 1\text{k}\Omega$, find the value of R_2 that results in a closed loop gain of 100 V/V.

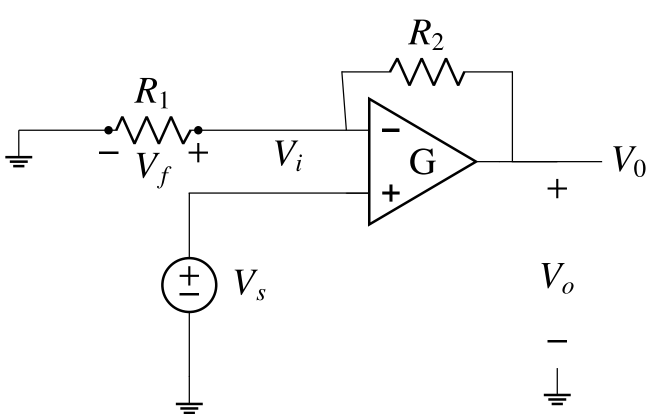

Fig. 1.1

Solution: The small signal equivalent fig. 1.1

Parameter	Value
input resistance	∞
output resistance	**0**
Input voltage	V_s
Output Voltage	V_o
Feeding resistance	R_1
Feedback resistance	R_2
Open Loop Gain, G	10^4V/V
Closed Loop Gain, T	**100 V/V**

TABLE 1.1

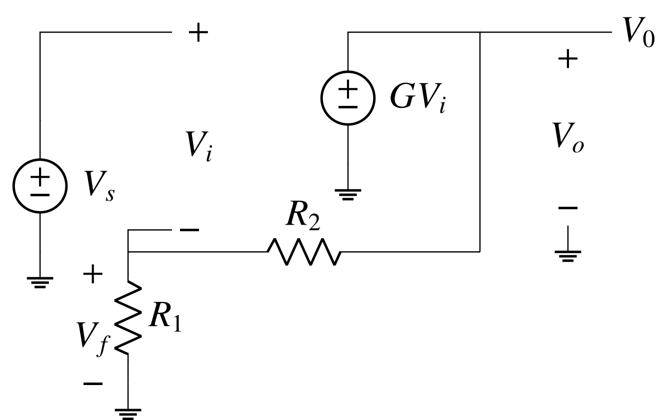

Fig. 1.1

$$V_f = \beta V_o \tag{1.1.1}$$
$$= \frac{R_1}{R_1 + R_2}.V_o \tag{1.1.2}$$
$$\implies \beta = \frac{R_1}{R_1 + R_2} \tag{1.1.3}$$
$$T = \frac{G}{1 + \beta G} \tag{1.1.4}$$
$$\implies \beta = \frac{1}{T} - \frac{1}{G} \tag{1.1.5}$$
$$= \frac{1}{100} - \frac{1}{10^4} \tag{1.1.6}$$
$$\implies \beta = 0.0099 \tag{1.1.7}$$

*The author is with the Department of Electrical Engineering, Indian Institute of Technology, Hyderabad 502285 India e-mail: gadepall@iith.ac.in.

Putting β in (1.1.3) gives
$\implies \mathrm{R}_2 = 100.01\ \mathrm{k}\Omega$

1.2. What does the gain become if R_1 is removed?
Solution: β goes to 0. So,

$$T = G \tag{1.2.1}$$