**1.** Consider the system with transfer function

$$G(s) = \frac{Ks+1}{s^3+s^2+(K+k)s+1}.$$

(a) For $K = 1$, find the sensitivity $S_k^G$ of this transfer function with respect to $k$ assuming nominal value $k = 2$. Then plot is magnitude as a function of frequency.

(b) Repeat (a) with $K = 100$ and compare the effect of a large loop gain on the sensitivity.

**2. In many instances, steady state errors in control system are due to some non-linearities such as dead zones. A 'Class B' amplifier is a typical example of a device having a dead zone where it takes ~1 Volt of input signal to turn on the transistor. Once the device is on, however, it can be assumed to function linearly. The Class B amplifier in Figure 1 can be characterized mathematically (assuming a 1V threshold voltage and $V_{cc} = \infty$) by $N(\cdot)$ which is given by:**

$$Y = \begin{cases} 0 & \text{if } -1 \le U \le 1, \\ U-1 & \text{if } U > 1, \\ U+1 & \text{if } U < -1. \end{cases}$$

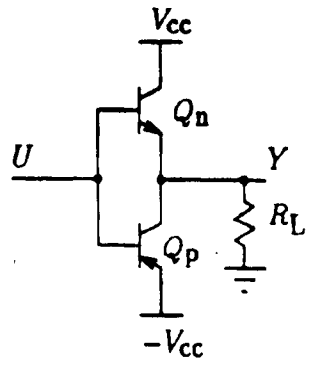


**Figure 1: Class B Amplifier Circuit**

**(a) Develop a plot of $Y$ versus $R$ with $K = 1$ in Figure 2.**

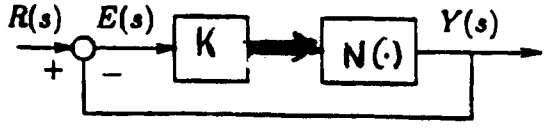


**Figure 2: Feedback System**

**(b) If $r(t) = 5\sin(t)$, sketch $y(t)$.**