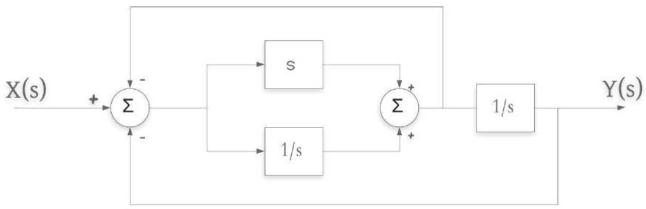

Fig. 1.1

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

1 Stability

1.1 Second order System

1.1. The Block diagram of a system is illustrated in the figure shown, where X(s) is the input and Y(s) is the output . The transfer function H(s)=Y(s)/X(s)

$$H(s) = \frac{Y(s)}{X(s)} \tag{1.1.1}$$

Options -

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

$$(B) - H(s) = \frac{s^2 + 1}{s^3 + 2s^2 + s + 1} \tag{1.1.3}$$

$$(C) - H(s) = \frac{s^2 + 1}{s^2 + s + 1} \tag{1.1.4}$$

$$(D) - H(s) = \frac{s^2 + 1}{2s^2 + 1} \tag{1.1.5}$$

Solution: Masons Gain Formula-

$$T = \frac{Y(s)}{X(s)} \tag{1.1.6}$$

$$T = \frac{\sum_{i=1}^{N} P_i \Delta_i}{\Delta} \tag{1.1.7}$$

Now, Signal flow graph of given above block diagram is
Pi is the ith forward path.

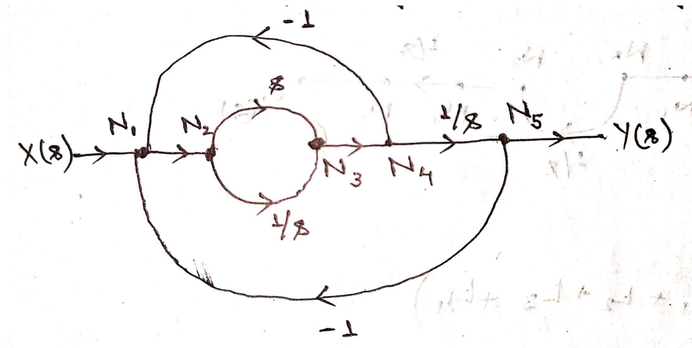

Fig. 1.1: signal flow graph

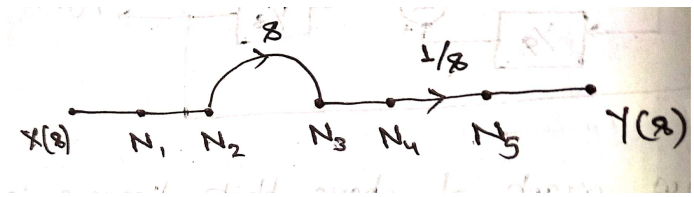

Fig. 1.1: P1

Here,

$$P_1 = \frac{s}{s} = 1 \tag{1.1.8}$$

$$P_2 = (1/s)(1/s) = 1/s^2 \tag{1.1.9}$$

$$\Delta = 1 - (L_1 + L_2 + L_3 + L_4)$$

$$L_1 = (-1)(s) = -s \tag{1.1.10}$$

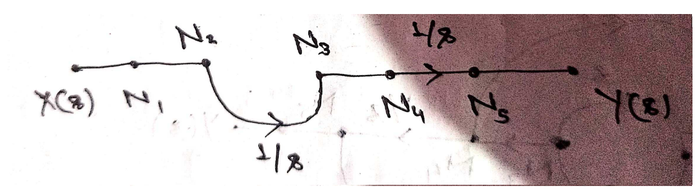

Fig. 1.1: P2

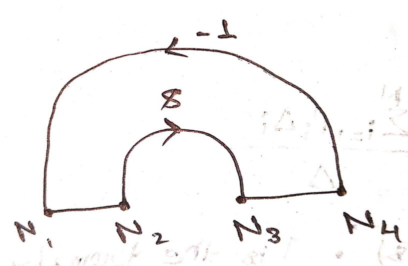

Fig. 1.1: L1

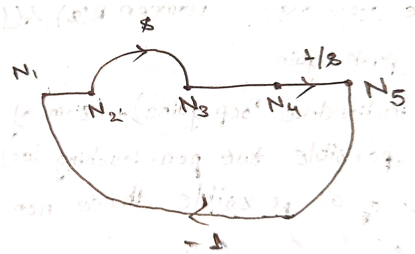

Fig. 1.1: L2

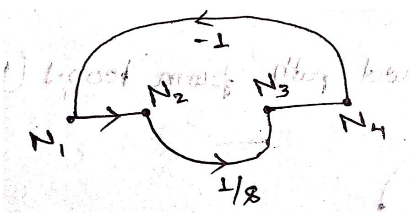

Fig. 1.1: L3

$$L_2 = \frac{s}{-s} = -1 \tag{1.1.11}$$

$$L_3 = (\frac{1}{s}) * (-1) = \frac{-1}{s} \tag{1.1.12}$$

$$L_4 = (\frac{1}{s}) * (\frac{1}{s})8(-1) = \frac{-1}{s^2} \tag{1.1.13}$$

$\Delta = 1 - (-s - 1 - \frac{1}{s} - \frac{1}{s^2})$ $\Delta = \frac{s^3+2s^2+s+1}{s^2}$
$\Delta_1 = 1$

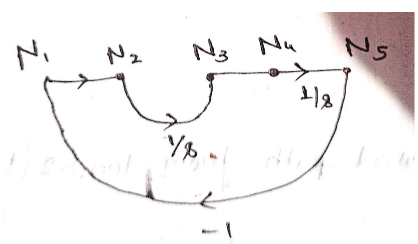

Fig. 1.1: L4

Fig. 1.1: Delta1

Fig. 1.1: Delta2

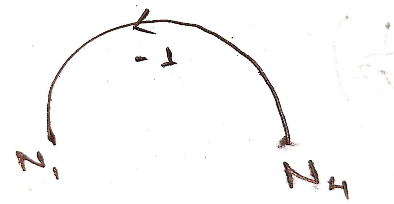

Fig. 1.1: Delta3

$\Delta_2 = 1$
$\Delta_3 = 1$
$\Delta_4 = 1$
Here,

$$T = \frac{\sum_{i=1}^{N}(P_i)(\Delta_i)}{\Delta} \tag{1.1.14}$$

$$T = \frac{P_1\Delta_1 + P_2\Delta_2 + P_3\Delta_3 + P_4\Delta_4}{\Delta} \tag{1.1.15}$$

$$T = \frac{1 * 1 + (\frac{1}{s^2}) * 1 + 0 * 1 + 0 * 1}{\frac{s^3+2s^2+s+1}{s^2}} \tag{1.1.16}$$

$$H(s) = \frac{s^2 + 1}{s^3 + 2s^2 + s + 1} \tag{1.1.17}$$

2 Routh Hurwitz Criterion

3 Compensators

4 Nyquist Plot

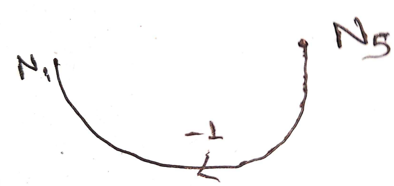

Fig. 1.1: Delta4