EE23BTECH11217 - Prajwal M*

Exercise 9.1

12 For the block diagram shown in the figure, the transfer function $\frac{Y(s)}{R(s)}$ is

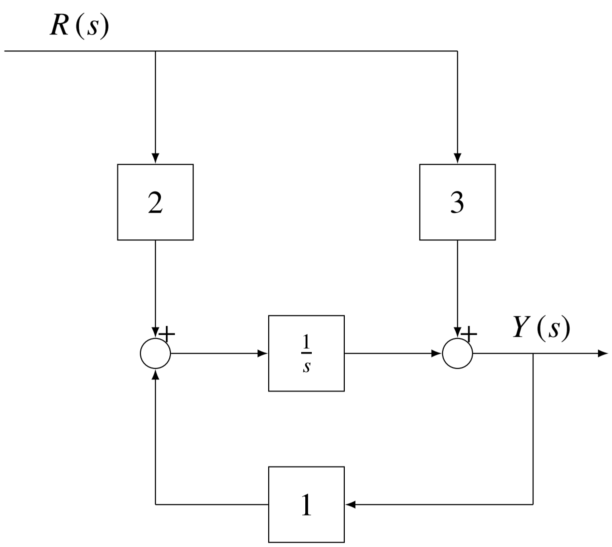

Fig. 1. block diagram

Solution:

Parameter	Description	Value
$Y(s)$	Output node variable	
$R(s)$	Input node variable	
$\frac{Y(s)}{R(s)}$	Transfer function	?
P_1	Forward path gain a-b-c	$\frac{2}{s}$
P_2	Forward path gain a-c	3
Δ_1	Determinant of forward path a-b-c	1
Δ_2	Determinant of forward path a-c	1
Δ	Determinant of system	$1-\frac{1}{s}$
n	Number of forward path	2

TABLE I
Parameters

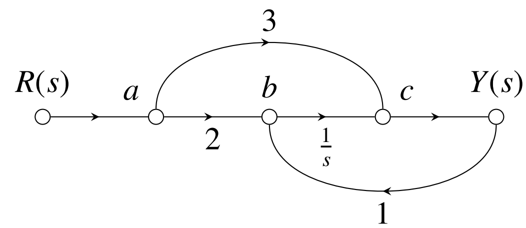

Fig. 2. signal flow graph

$$P_1 = 2\left(\frac{1}{s}\right) = \frac{2}{s} \tag{1}$$
$$P_2 = 3 \tag{2}$$
$$\Delta_1 = 1 - (0) = 1 \tag{3}$$
$$\Delta_2 = 1 - (0) = 1 \tag{4}$$
$$L_1 = \frac{1}{s} \tag{5}$$
$$\Delta = 1 - L_1 = 1 - \frac{1}{s} \tag{6}$$

from Fig. 2 using Mason's Gain Formula,

$$\frac{Y(s)}{R(s)} = \frac{\sum_{i=1}^{n} P_i \Delta_i}{\Delta} \tag{7}$$
$$= \frac{P_1\Delta_1 + P_2\Delta_2}{\Delta} \tag{8}$$
$$= \frac{\frac{2}{s} + 3}{1 - \frac{1}{s}} \tag{9}$$
$$H(s) = \frac{Y(s)}{R(s)} = \frac{3s+2}{s-1} \tag{10}$$

$$H(s) = \frac{5}{s-1} + 3 \tag{11}$$
$$H(s) \overset{\mathcal{L}^{-\infty}}{\longleftrightarrow} h(t) \tag{12}$$
$$\frac{5}{s-1} \overset{\mathcal{L}^{-\infty}}{\longleftrightarrow} 5e^{t} \tag{13}$$
$$3 \overset{\mathcal{L}^{-\infty}}{\longleftrightarrow} 3\delta(t) \tag{14}$$

using (13) and (14),

$$h(t) = 5e^{t} + 3\delta(t) \tag{15}$$

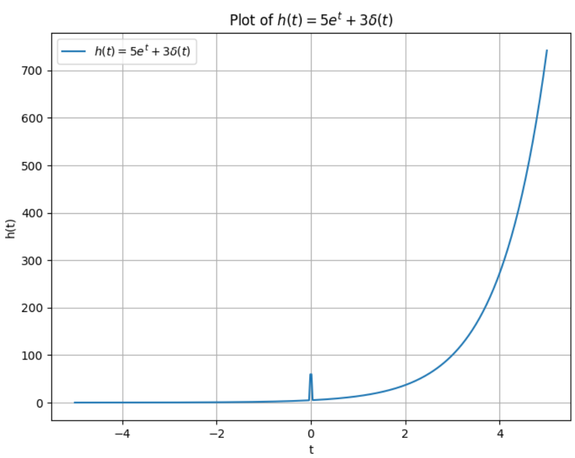

Fig. 3. Plot of impulse response of the system