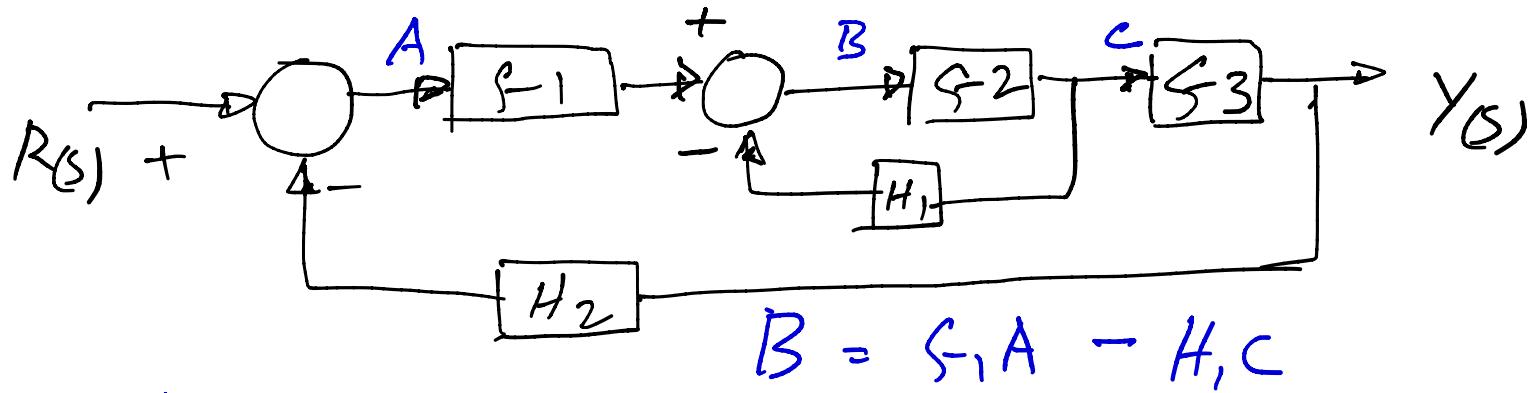


SOLUTIONS CLASS TEST

ELET3220 2020

1



$$A = R - H_2 Y$$

$$Y = B f_2 f_3$$

$$C = B f_2$$

$$B = \frac{Y}{f_2 f_3}$$

$$Y = (f_1 A - H_1 C) \frac{f_2 f_3}{f_2 f_3}$$

$$Y = (f_1 R - f_1 H_2 Y - H_1 B f_2) f_2 f_3$$

$$Y = f_1 f_2 f_3 R - f_1 f_2 f_3 H_2 Y - H_1 f_2 \cancel{f_2 f_3} Y$$

$$\cancel{f_2 f_3}$$

$$Y [1 + f_1 f_2 f_3 H_2 + H_1 f_2] = f_1 f_2 f_3 R$$

$$Y[1 + \varsigma_1 f_2 f_3 H_2 + H_1 f_2] = \varsigma_1 f_2 f_3 R$$

$$\frac{Y}{R} = \frac{\varsigma_1 f_2 f_3}{1 + \varsigma_1 f_2 f_3 H_2 + H_1 f_2}$$

BY MASON'S GAIN FORMULA

FORWARD PATH IS $S_1 S_2 S_3$

LOOPS $L_1 = -H_1 S_2$

$$L_2 = -H_2 f_1 f_2 f_3$$

$$\Delta = 1 - (-H_1 S_2 - H_2 f_1 f_2 f_3)$$

$$\frac{Y(s)}{R(s)} = \frac{S_1 S_2 S_3}{1 + H_1 S_2 + H_2 f_1 f_2 f_3}$$

$$\underline{Q.2} \quad Y(s) = \frac{s+3}{s^2 + 9s + 14} R(s)$$

$$\text{Since } R_s = \frac{1}{s}$$

$$Y(s) = \frac{s+3}{s(s+7)(s+2)}$$

USE PARTIAL FRACTION EXPANSION

$$Y(s) = \frac{A_1}{s} + \frac{A_2}{s+7} + \frac{A_3}{s+2}$$

$$s+3 = A_1(s+7)(s+2) + A_2 s(s+2) \\ + A_3 s(s+7)$$

$$\text{LET } s=0$$

$$3 = A_1 \cdot 14 \quad \therefore A_1 = \frac{3}{14} = 0.214$$

$$\text{LET } s = -7$$

$$-4 = A_2 \rightarrow (-5) \quad \therefore A_2 = -\frac{4}{35}$$

$$A_2 = -0.114$$

LET $S = -2$

$$S+3 = A_1(s+7)(s+2) + A_2 s(s+2) \\ + A_3 s(s+7)$$

$$1 = A_3 - 2(s) \therefore A_3 = -\frac{1}{10}$$

$$A_3 = -0.1$$

$$\text{So } Y(s) = \frac{0.214}{s} - \frac{0.114}{s+7} - \frac{0.1}{s+2}$$

USING LAPLACE TRANSFORMS

$$y(t) = 0.214 - 0.114e^{-7t} - 0.1e^{-2t}$$

$$\lim_{t \rightarrow \infty} y(t) = 0.214$$

Q.3 $f(s) = \frac{2s+4}{3s^2+5s+10}$

$$\frac{-5 \pm \sqrt{s^2 - 4(3)10}}{2(3)}$$

$$\frac{-5 \pm \sqrt{95}}{6}$$

THE SYSTEM

THE POLES:

$$-0.833 \pm j1.624 \quad \text{HAS ONE ZERO WHEN } s = -2$$

NATURAL FREQ. IS $\sqrt{\frac{10}{3}} = 1.826 \text{ Hz}$

DAMPING RATIO IS $\frac{5/3}{2(1.826)} = 0.456$

SETTING TIME (T_{90}) IS $\frac{4}{0.456(1.826)} = 4.8 \text{ s}$

THE O.S. IS $100 e^{-\frac{0.456 \pi}{\sqrt{1-0.456^2}}} = 20$

THE SYSTEM IS UNDER DAMPED