ELL 225 CONTROL ENGG (ELL...)

16/2/2015

MINOR TEST I

Time: 1 hr. Marks: 20

Q1: (a) Let $f(t) = \exp(-\alpha|t|)$ where $\alpha > 0$ & $-\infty < t < \infty$. Now, consider $g(t) = \int_{-\infty}^{t} f(\tau)\,d\tau$. Find unilateral L.T. of $g(t)$.

(b) Consider rotational mech. system shown in Fig. 1 where $T(t)$ is input torque and $\theta(t)$ output displacement.

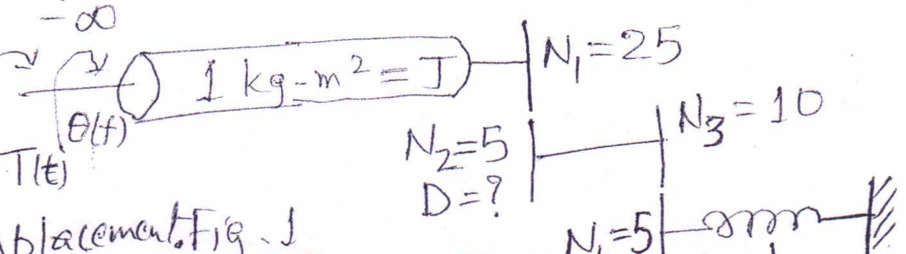


Fig. 1

The gear N_2 is lossy with damping D. Find D such that for unit step torque input, the output angular displacement has 30% max^m overshoot. (5)

Q2:- For the unity feedback shown in fig. 2, construct a parameter plane $k_1 - k_2$ where k_1 is horizontal axis and show the following regions in $k_1 - k_2$ plane:

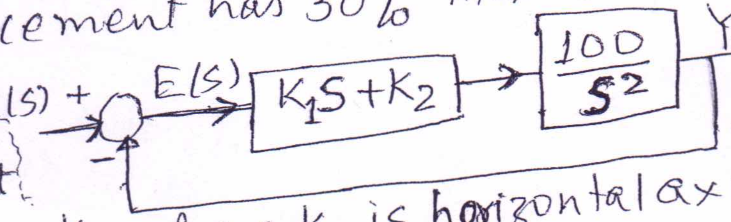


Fig. 2

(i) Stable and unstable region.

(ii) Region in which system is overdamped ($\xi > 1$)

(iii) Region in which natural undamped frequency is greater than 5 and system is underdamped and stable (5)

Q.3:- A controlled process is represented by following equations:

$$\frac{dx_1}{dt} = -x_1(t) + 5x_2(t)$$

$$\frac{dx_2}{dt} = -6x_1(t) + u(t)$$

$$y = x_1(t)$$

where control input is obtained from $u(t) = -k_1 x_1 - k_2 x_2 + r(t)$, $r(t)$ is reference input.

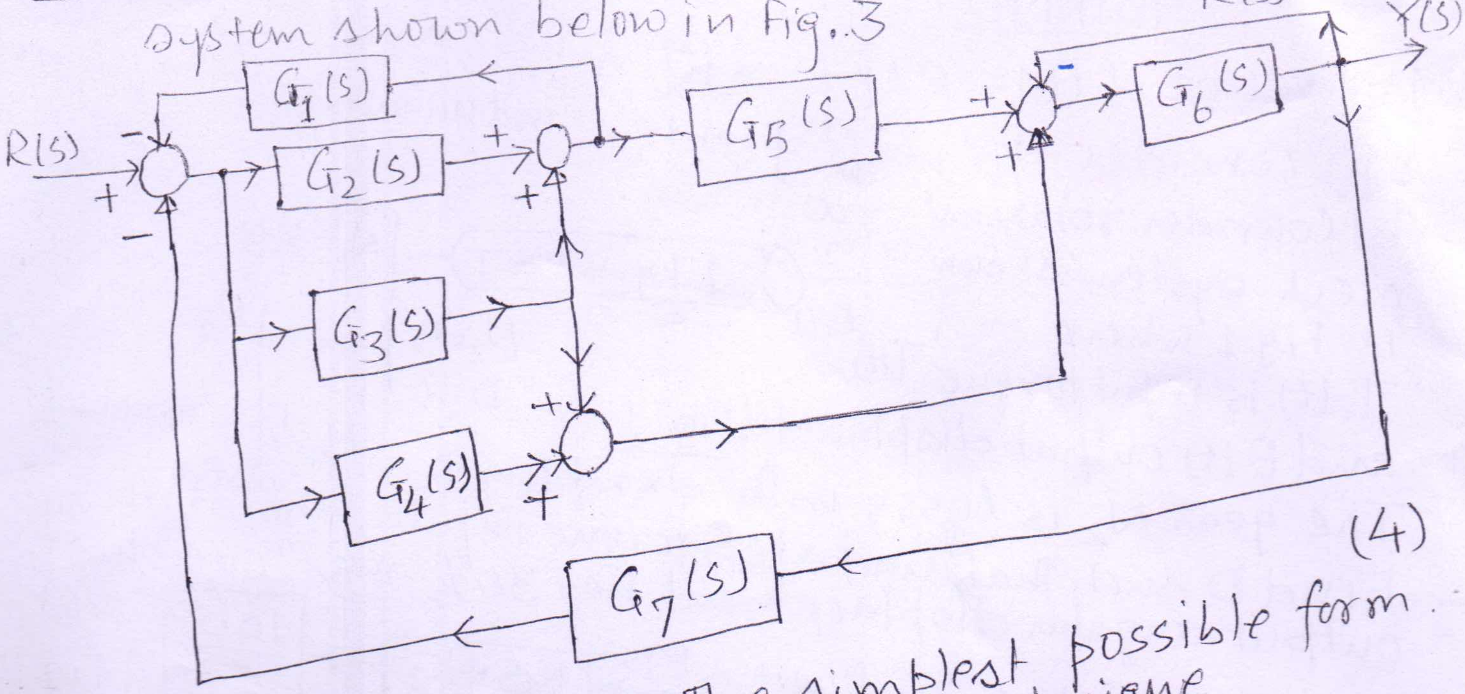
(a) Find the region in $k_1 - k_2$ plane (k_1 = vertical axis) such that overall system has damping ratio $0 < \xi < 0.707$

(b) Find values of k_1 and k_2 such that $\xi = 0.707$ and $\omega_n = 10$

(c) Find the locus in $k_1 - k_2$ plane such that $\lim_{t \to \infty} y(t) = 1$ when $r(t)$ is a unit step signal. (6)

P.T.O.

Q.4:- Find the overall transfer function $T(s) = \frac{Y(s)}{R(s)}$ for system shown below in Fig..3



(4)

Give answer in the simplest possible form using block diagram ~~red~~ reduction technique.