ASSIGNMENT 3

TRANSIENT AND STEADY STATE RESPONSE ANALYSIS

(1) Close loop transfer function of control system is given by

$$\frac{C(s)}{R(s)} = \frac{K}{S^4 + 6S^3 + 30S^2 + 60S + K}$$

(a) Determine the range of K must be lie for the system to be stable.
(b) What should be upper limit of K is all the close loop pole are required to be the left side of the line (σ = -1). (June 2013, 7 Marks)

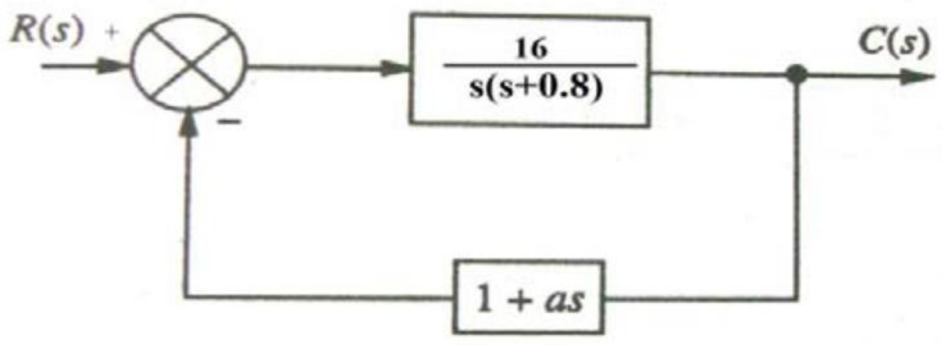
(2) Derive expression of response, c (t), of second order unity feedback system who's closed-loop transfer function is given below, for a unit step input as a function of time t and damping ratio ζ. Derive expression of c (t) for ζ=0 and ζ=1

$$T_s = \frac{C(s)}{R(s)} = \frac{\omega_n^{\ 2}}{S^2 + 2\xi\omega_n + \omega_n^{\ 2}}$$

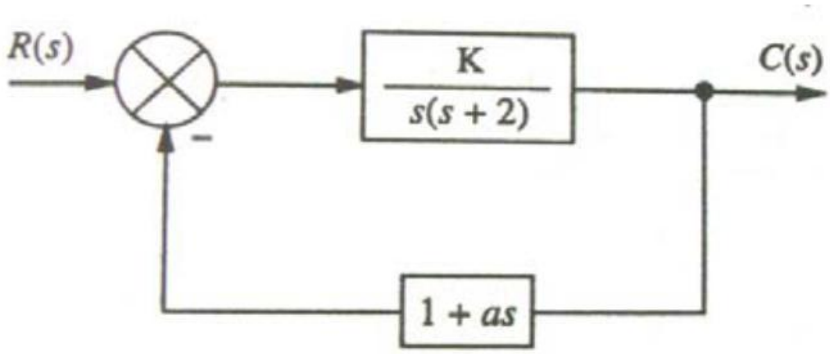
Also Derive expressions of (i) Rise time, tr (ii) Peak time, tp and (iii) Peak overshoot, Mp for the system

(3) A second order control system is subjected to unit step input. Draw response curves for underdamped, overdamped and critically damped system. For underdamped system define various performance indices.

(4) Consider the system as shown in figure. Determine the value of '*a*' such that the damping ratio is 0.5. Also obtain the values of rise time and maximum overshoot Mp in its step response.



(5) Determine the value of '*K*' and '*a*' such that the system has a damping ratio of 0.7 and an undamped natural frequency of 4 rad/sec for the system shown below



(6) Write note on steady state error and error constants

(7) Explain about time constant of first and second order control system?

(8) Find out the output response c (t) of the transfer function shown below for the step input.

$$\frac{C(s)}{R(s)} = \frac{5}{(s+1)}$$

Plot the step response on the graph paper

(9) For the second order system with transfer function as given below, obtain Maximum percentage overshoot M_p and peak time T_p.

$$G(s) = \frac{4}{s^2 + 2s + 4}$$

(10) For a unity feedback control systems shown below, obtain steady state error for step input

$$G_1(s) = \frac{10}{s^2 + 14s + 50} \text{ and } G_2(s) = \frac{10}{s(s^2 + 14s + 50)}$$