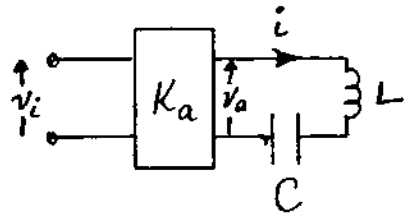
EE 231 **Exam#2** Oct. 24, 1989
75 minutes

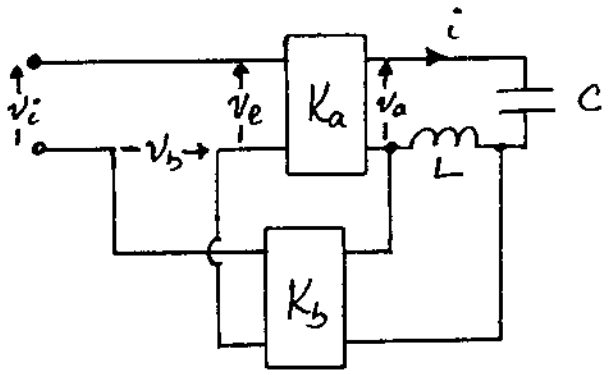
1. The following oscillator is designed for the output current to oscillate at a certain frequency,



where $L = 8$ Henry's and $C = 2$ Farads.

(a) Determine the frequency of the oscillations. (10pts)

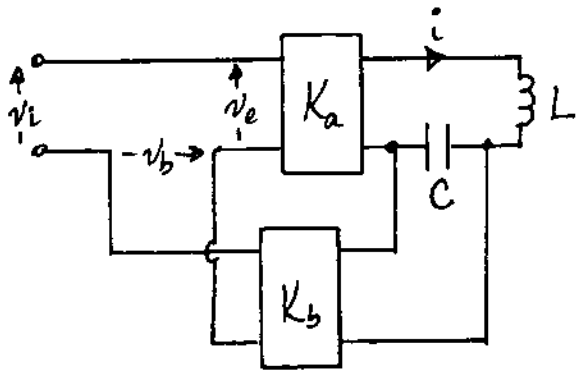
To change the frequency of oscillation a nonloading voltage feedback is designed as follows;



(b) Assuming that $K_a = 0.5$, determine K_b such that the output current oscillates at $\omega = 0.125$ rad/sec. (30pts)

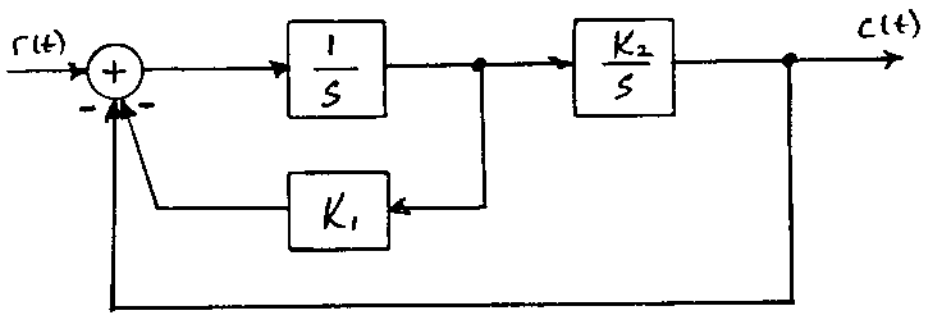
(c) Determine the sensitivity of the transfer function with respect to K_b at the desired frequency. (15pts)

However, due to ~~carefulness~~ carelessness during the implementation, the following system is realized;



(d) Determine the new frequency of oscillation for the realized system and for $K_a = 0.5$ and the value of K_b found in part (b). (10pts)

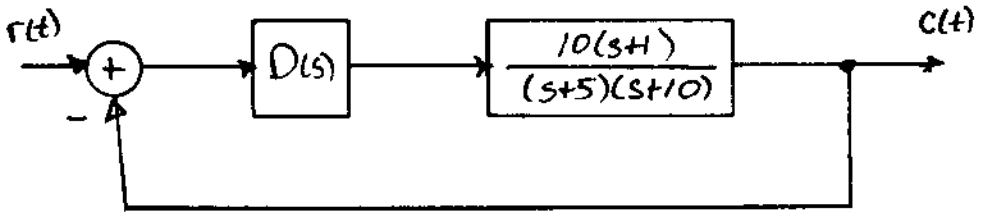
2. For the following system,



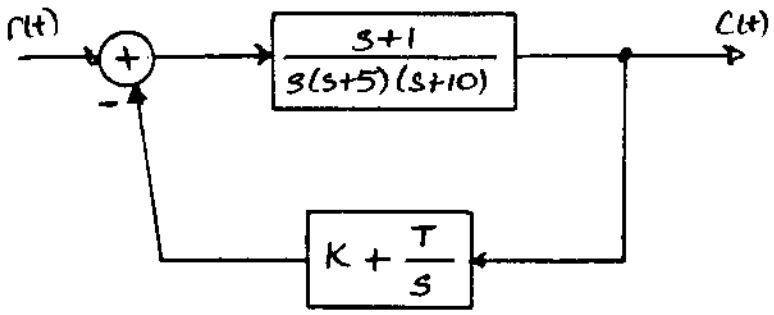
(a) Determine the constants K_1 and K_2, such that the normalized maximum overshoot is less than 0.01, the rise time is less than 0.5 sec and the peak time is less than 0.6 sec for a step input. (25pts)

(b) Obtain the expression for the actual settling time (not an approximation), sketch the time response and show the rise time, the peak time and the actual settling time on the sketch. (15pts)

3. Design a simple compensator $D(s)$, such that the static velocity error coefficient is at least 20 for the following system, (20pts)



4. Determine K and T, such that the following system is asymptotically stable. (25pts)



#1 a// $\omega = 0.25$ rad/sec

b// $K_b = 6$

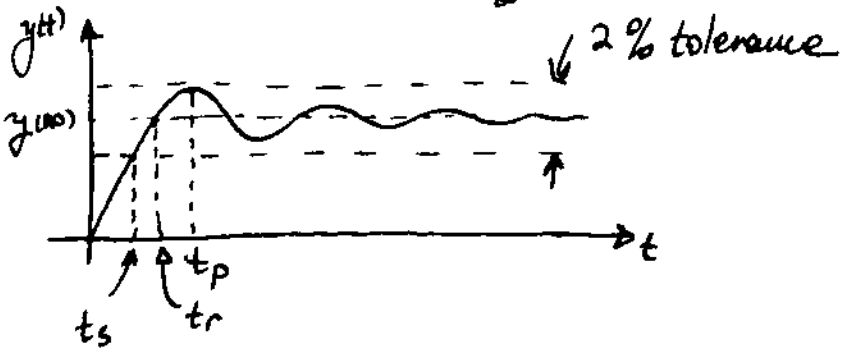
c// $S_{K_b}^{\Omega/V_i} = \infty$

d// $\omega = 0.5$ rad/sec

#2 a// One choice: $K_1 = 17$

$K_2 = 100$

b// $e^{-\sigma_0 t_s}\left(\cos \omega_d t_s + \frac{\sigma_0}{\omega_d} \sin \omega_d t_s\right) = 0.02$



#3 One choice: $D(s) = \frac{100}{s}$

#4 $0 < T < 14K + 750$

$14K^2 + 13KT - T^2 + 750K + 525T > 0$