UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE AND ENGINEERING
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ECE356S – System and Signal Analysis II

Midterm Test – March 1999

(10 pts)

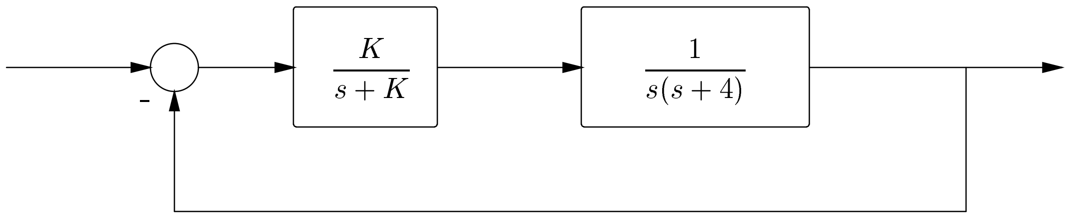
1. Suppose the transition matrix e^{At} is given by

$$e^{At} = \begin{bmatrix} \frac{1}{2}(3e^{-t} - e^{-3t}) & \frac{1}{2}(e^{-t} - e^{-3t}) \\ -\frac{3}{2}(e^{-t} - e^{-3t}) & \frac{1}{2}(3e^{-3t} - e^{-t}) \end{bmatrix}$$

Determine the matrix A.

(20 pts)

2. Consider the following feedback system



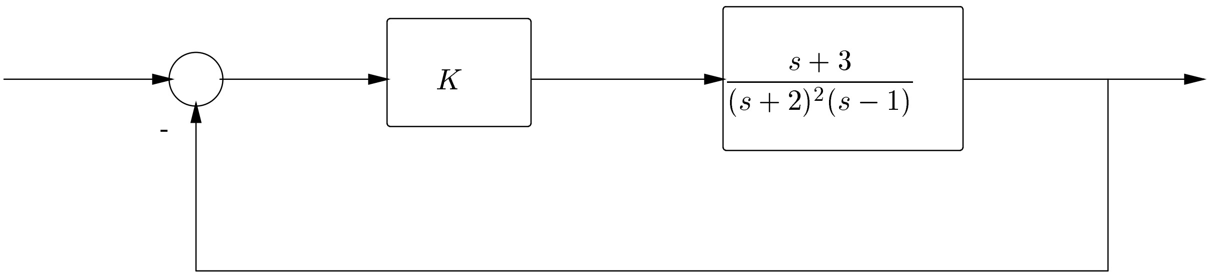
where $K > 0$ is an adjustable parameter.

(i) Sketch the root locus of the closed loop system as a function of the parameter K, and determine the range of values of K for closed loop stability.

(ii) The relative degree of the loop transfer function is 3. Do the results of (i) contradict the usual root locus behaviour for relative degree 3 systems? Explain your answer.

(20 pts)

3. Consider the following feedback system



The gain K is > 0.

(i) Putting

$$P(s) = \frac{s+3}{(s+2)^2(s-1)}$$

sketch the Nyquist plot of $P(s)$.

(ii) Using the results of (i), determine the range of values of the gain K for which the closed loop system is stable.