UNIVERSITY OF VICTORIA

FINAL EXAMINATION, DECEMBER 1999

ELEC 360 - CONTROL THEORY AND SYSTEMS: I

SECTION F01

TO BE ANSWERED IN BOOKLETS

TIME: 3 HOURS
INSTRUCTOR: P. Agathoklis

FOUR PAGES OF HANDWRITTEN NOTES AND PHOTOCOPIES OF LAPLACE TRANSFORMS ARE PERMITTED.

STUDENTS MUST COUNT THE NUMBER OF PAGES IN THIS EXAMINATION PAPER BEFORE BEGINNING TO WRITE, AND REPORT ANY DISCREPANCY IMMEDIATELY TO THE INVIGILATOR.

THIS QUESTION PAPER HAS SIX (6) PAGES.

Marks

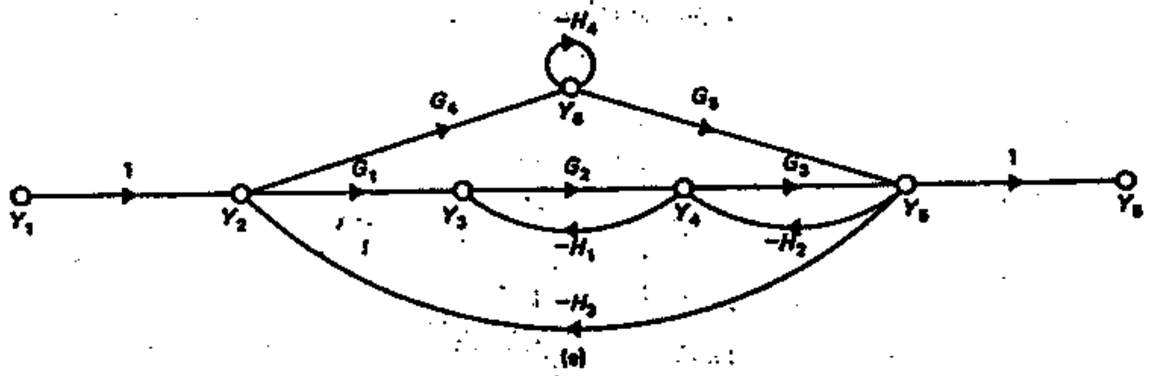
(4) 1. Find the output of a system having an impulse response given by

$$g(t)=\begin{cases}1-e^{-t} \text{ for } t\geq 0\\ 0 \qquad\quad else\end{cases}$$

to the following input signal

$$u(t)=\begin{cases}t \text{ for } 0\leq t\leq 1\\ 0 \qquad\quad else\\ 1 \text{ for } t \geq 1\end{cases}$$

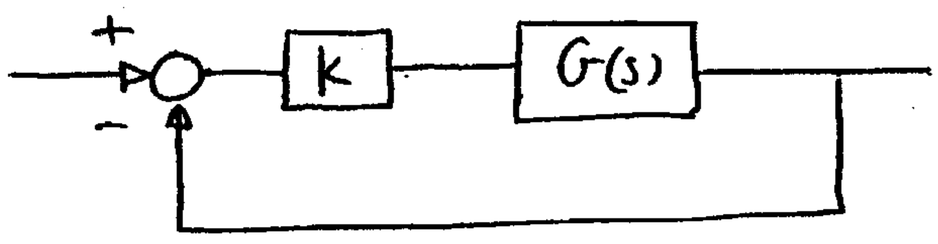
(4) 2. Find the transfer function between Y(s) and U(s) for:



(a)

Marks

(8) 6. **Discuss the stability of the following closed-loop systems using the Nyquist stability criterion.**



(a) $$G(s)=\frac{1}{(s+1)(s+2)(s+5)}$$

(b) $$G(s)=\frac{(s+1)}{s(s-3)}$$

(6) 7. **For the uncompensated system, find:**

i) The type of the system.
ii) The error coefficient which is not 0 to ∞ (give the value)
iii) The phase and the gain margins.

For the compensated system, find:

i) The type of compensator used.
ii) The phase and gain margins.
iii) What is the effect of using a compensator on the system's response?

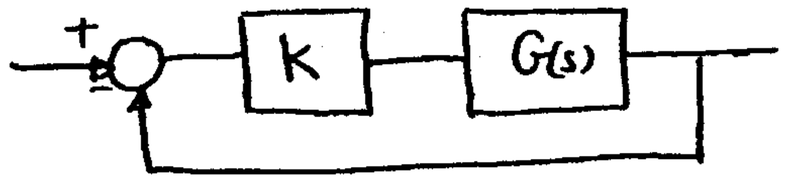
Justify your answers by indicating in the figure the corresponding quantities!

WRITE your NAME and STUDENT ID NUMBER on the attached sheet for Question 7. Include this sheet with your booklet.

Marks

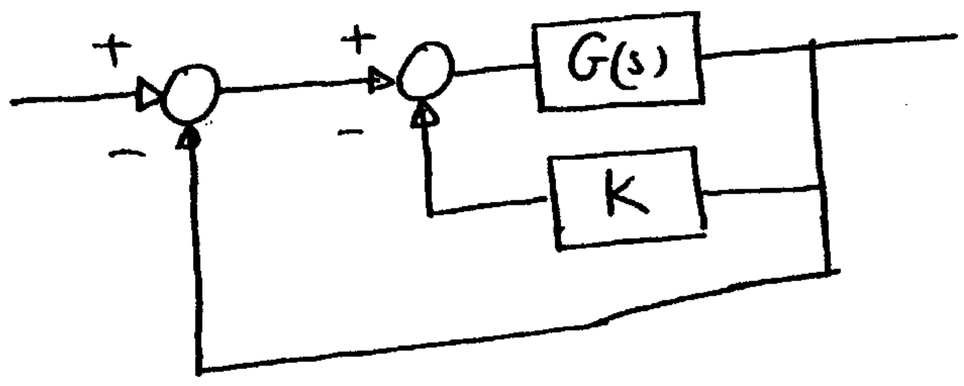
(8) **5. Sketch the root locus for the following system for K between 0 and ∞**

(a)



with $G(s) = \dfrac{1}{s(s^2+6s+11)}$

(b)

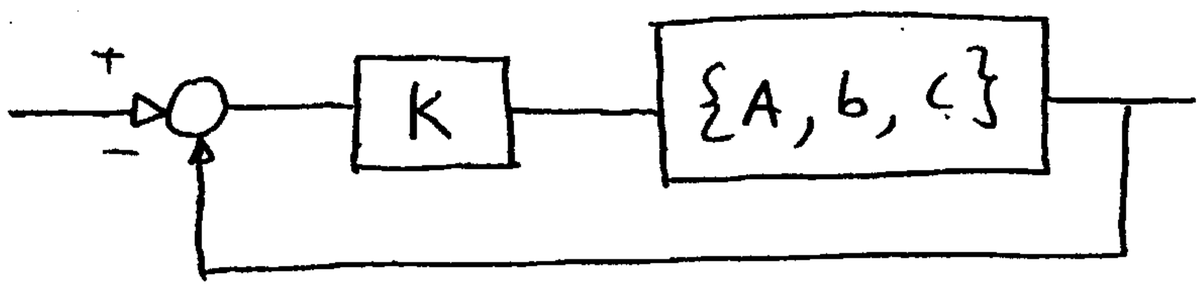


with $G(s) = \dfrac{s+2}{s(s+1)}$

Discuss briefly the effect of changing K to the step response of the closed-loop system in both (a) and (b).

Marks

(5) **3. Find for what values of K is the following system stable:**



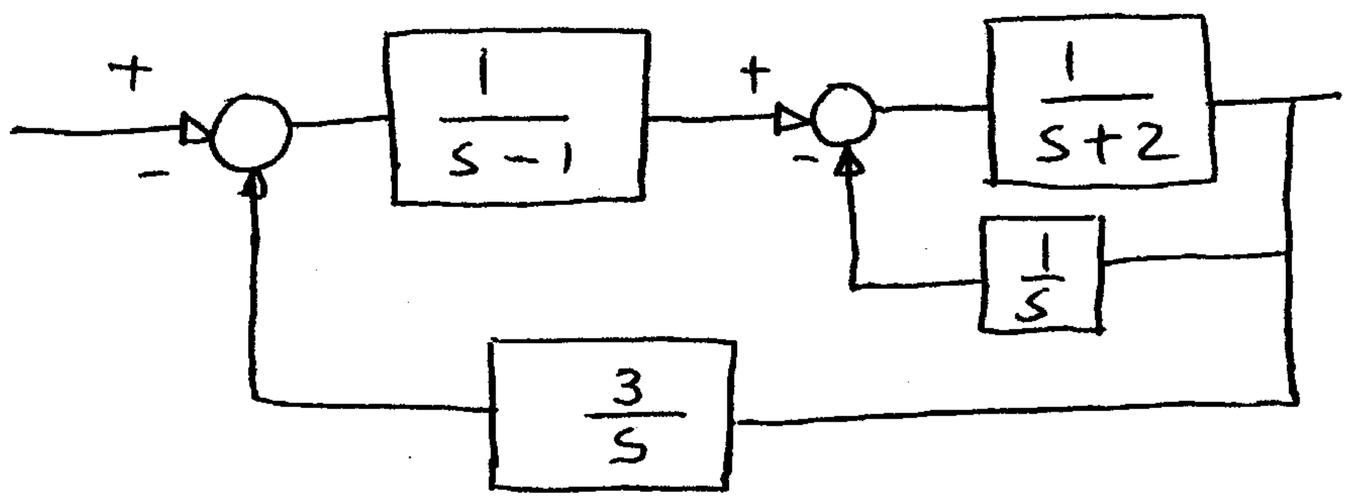
where {A, b c} represents:

$$\dot{\underline{x}} = A\underline{x} + \underline{b}u$$
$$y = \underline{c}\underline{x}$$

with

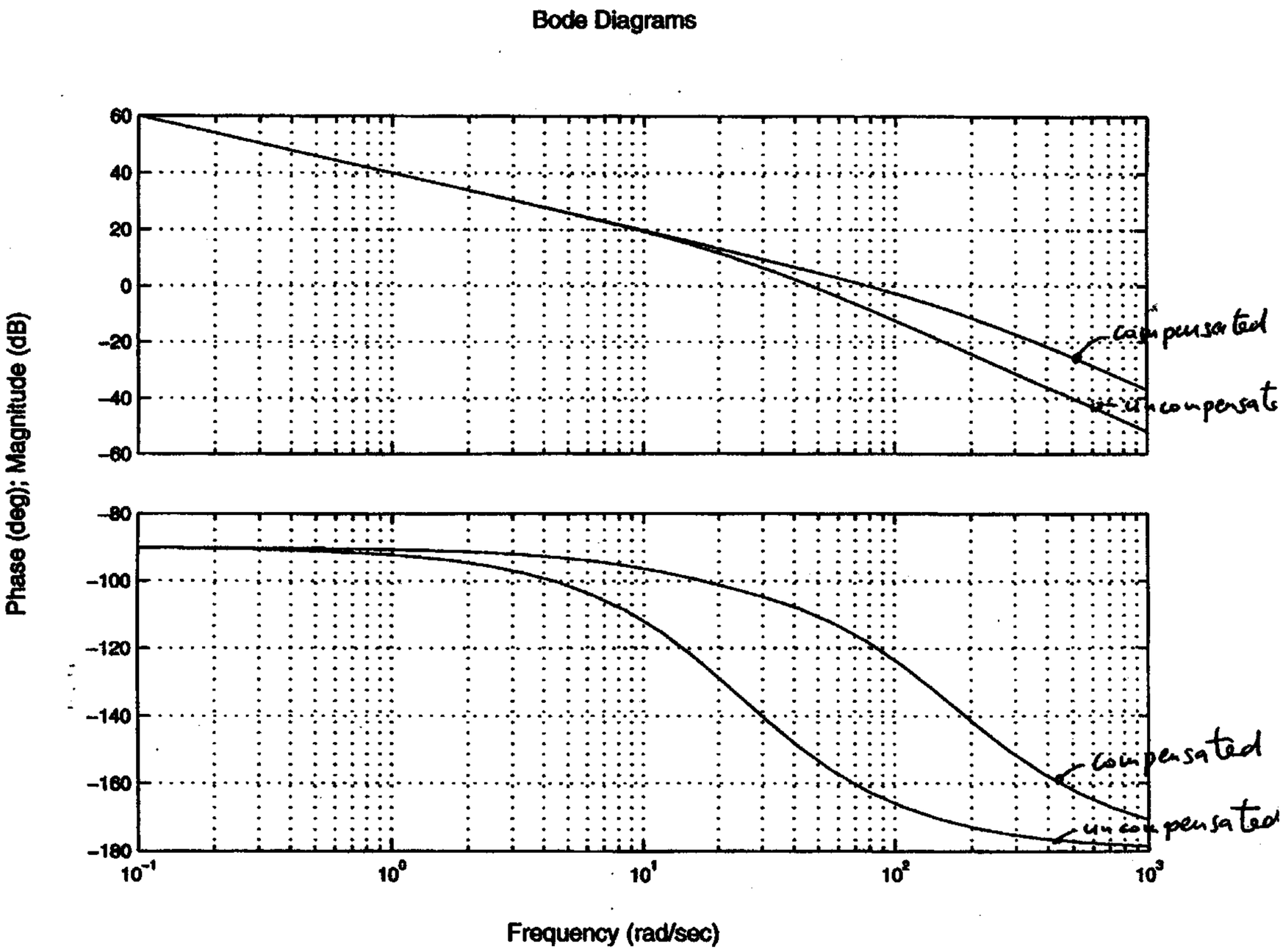
$$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -2 \\ 0 & 1 & -3 \end{bmatrix} \quad \underline{b} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \quad \underline{c} = [0, \ 0, \ 1]$$

(4) **4. Find the state-space description of a system given by:**



Question 7.

NAME:_____ **STUDENT ID:**_____



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