UNIVERSITY OF VICTORIA

EXAMINATIONS DECEMBER 1996

ELEC 360 : CONTROL THEORY AND SYSTEMS: I

SECTION F01

TO BE ANSWERED IN BOOKLETS

TIME: 3 hours
INSTRUCTOR: P. Agathoklis

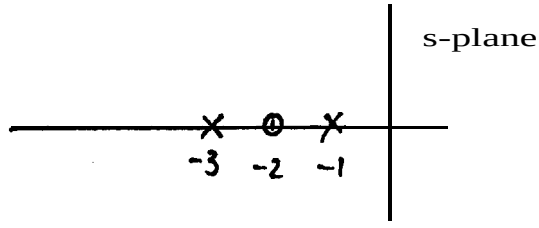
SIX PAGES OF HANDWRITTEN NOTES ARE PERMITTED

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 FIVEPAGES-

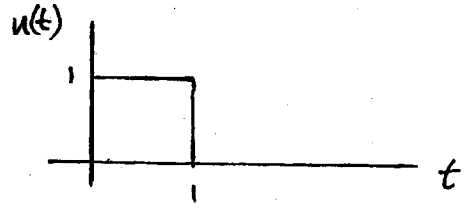
Marks

(6) 1. The **pole-zero** configuration of a system is given by

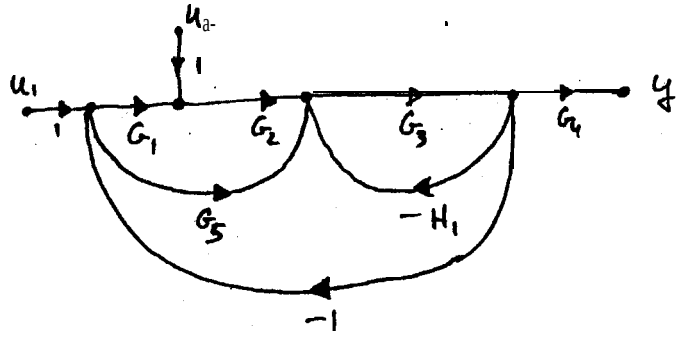


and the output of the system to a unit step is 1 at steady state.

(a) Find the transfer function.
(b) Find the response of the system to an input given by:



(4) 2. Find the transfer functions y/u1 and y/u2



Marks

(6) 3. Sketch the root-locus for

$$G(s) = \frac{K(s + 6)}{s(s + 3)}$$

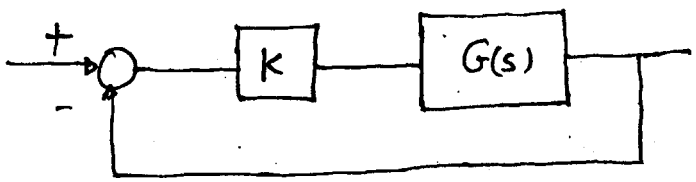
$$G(s) = \frac{K(s + 6)}{(s + 2)(s^2 + 5s + 12.25)}$$

(6) 4- Sketch the Bode and Nyquist plots for

$$G(s) = \frac{100K(s - 1)}{s^2(s + 3)(s + 30)}$$

and evaluate the closed-loop stability for K between 0 and ∞ using the Nyquist criterion.

(6) 5. Consider the system given by

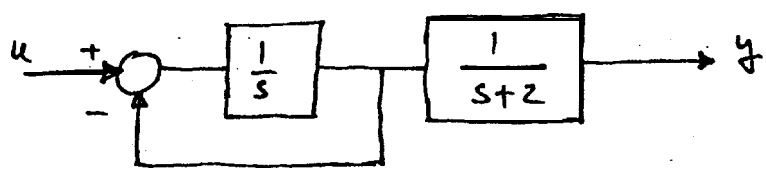


with $G(s) = \frac{1}{s(s + 5)^2}$

(a) Find K so that the steady state error to a unit ramp is less than 0.2.
(b) For what values of K is the condition of (a) satisfied and the closed-loop system is also stable?

Marks

(5) **6.** Find a state-space representation for



(2) **7.** Give the definitions for:

(a) Order of the system.
(b) Type of the system.
(c) Minimum phase systems.

(6) 8. The Bode plots of the uncompensated and compensated systems are given in page 5.

For the uncompensated system find (assume that there are no poles or zeros outside the area plotted except poles at the origin).

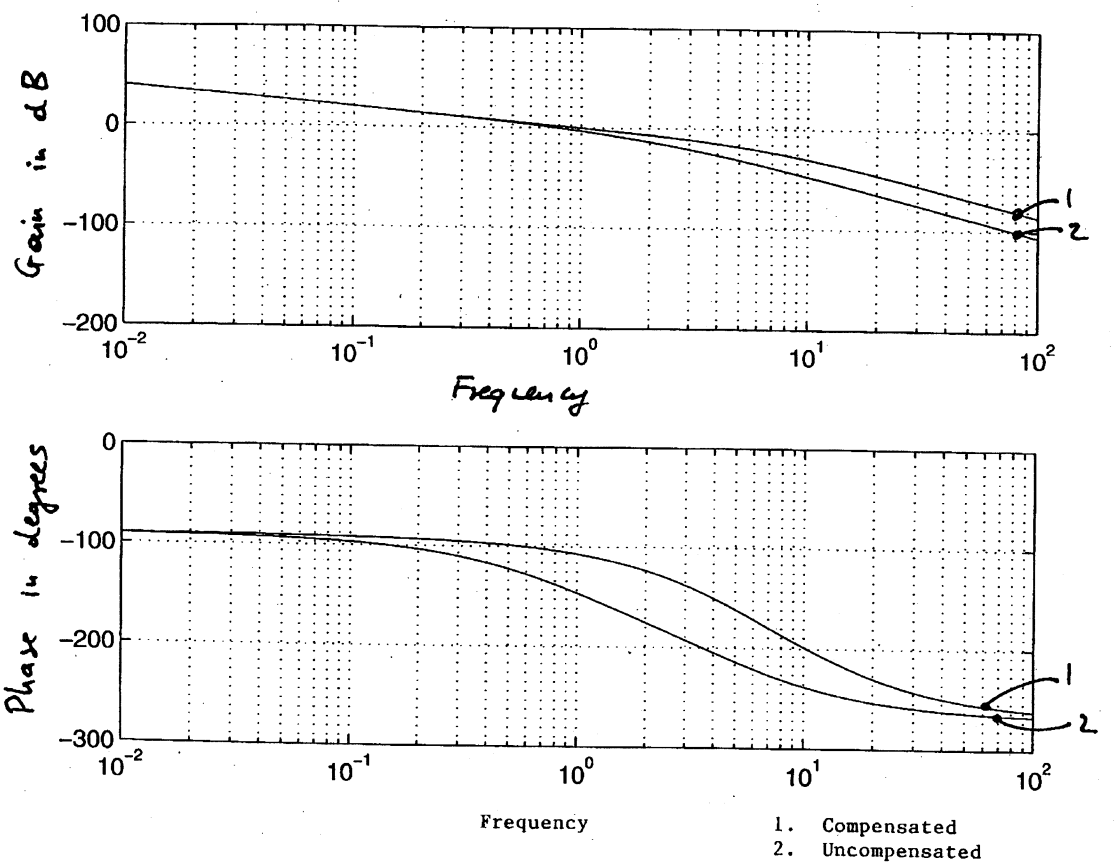
i) The type fo the system.
ii) The error coefficient which is not 0 or ∞ (give the value).
iii) The phase and the gain margins.

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!

NAME:_____ STUDENT ID: _____



1. Compensated
2. Uncompensated

END