

UNIVERSITY OF VICTORIA
FINAL EXAMINATIONS – DECEMBER 2001
ELEC 360 – CONTROL THEORY AND SYSTEMS I
SECTION F 01

TO BE ANSWERED IN BOOKLETS

DURATION: 3 Hours

INSTRUCTOR: Dr. P. Agathoklis

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

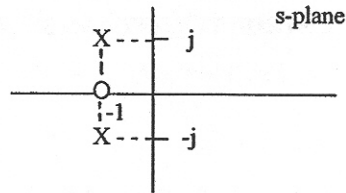
THIS QUESTION PAPER HAS 5 PAGES, INCLUDING THIS COVER PAGE AND ONE ATTACHED FIGURE.

FOUR (4) PAGES OF HANDWRITTEN NOTES AND PHOTOCOPIES OF LAPLACE TRANSFORMS ARE PERMITTED.

DETACH PAGE 5 FROM THE EXAMINATION PAPER AND HAND IT IN WITH YOUR ANSWER BOOKLET.

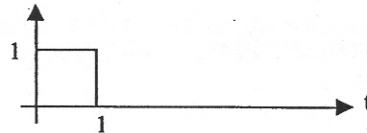
Marks

- (4) 1. The pole-zero configuration of a system is given by:

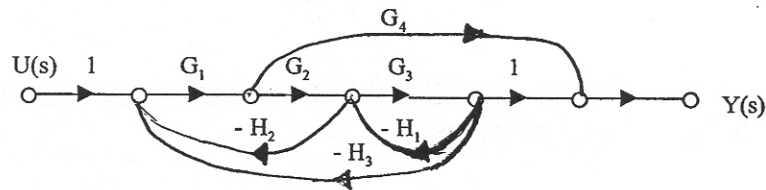


and the output of the system to a unit step is 2 at steady state (X is a pole, O is a zero).

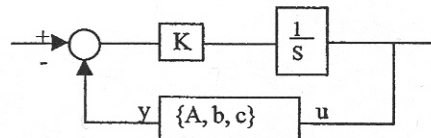
- (a) Find the transfer function of the system
(b) Find the response of the system to an input given by:



- (4) 2. Find the transfer function of $Y(s)/U(s)$



- (6) 3. (a) Sketch the root locus of



where $\{A, b, c\}$ is given by

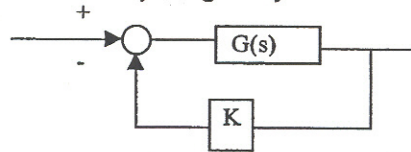
$$\dot{x} = \begin{bmatrix} -1 & 2 \\ 0 & -3 \end{bmatrix} x + \begin{bmatrix} 1 \\ 2 \end{bmatrix} u$$

$$y = [0 \ 1] x$$

and K goes from 0 to ∞

- (b) Discuss the transient response behaviour and the steady-state error behaviour of this system when K goes from 0 to ∞ .

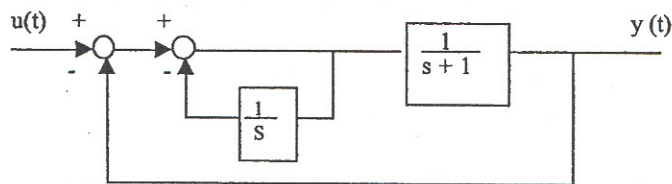
- (4) 4. Consider the system given by:



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

- (a) For what values of K is the closed loop system stable?
(b) Find K so that the steady state error for a unit ramp input is less than 0.4

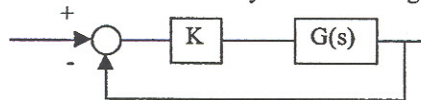
- (4) 5. Find a state-space description for



- (6) 6. Sketch the Bode diagram and the Nyquist plot for

$$G(s) = \frac{K(s-2)}{s^2(s+1)(s+10)}$$

and determine the stability of the following system

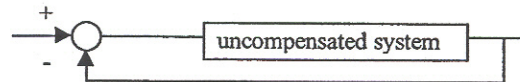


when K goes from 0 to ∞ using the Nyquist stability criterion.

- (6) 7. The Bode plots of the open loop compensated and uncompensated system are given in page 5.

From the plot of the uncompensated system, determine:

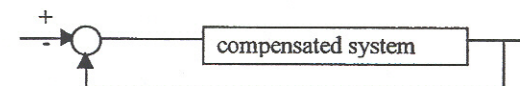
- (a) The stability of the closed-loop system



- (b) The type of open-loop system and the value of the corresponding static error coefficient.
(c) The phase and gain margins.

From the plot of the compensated system, determine:

- (a) The compensator used
(b) The new phase and gain margins
(c) Discuss the effects of using a compensator – what has been improved and how?



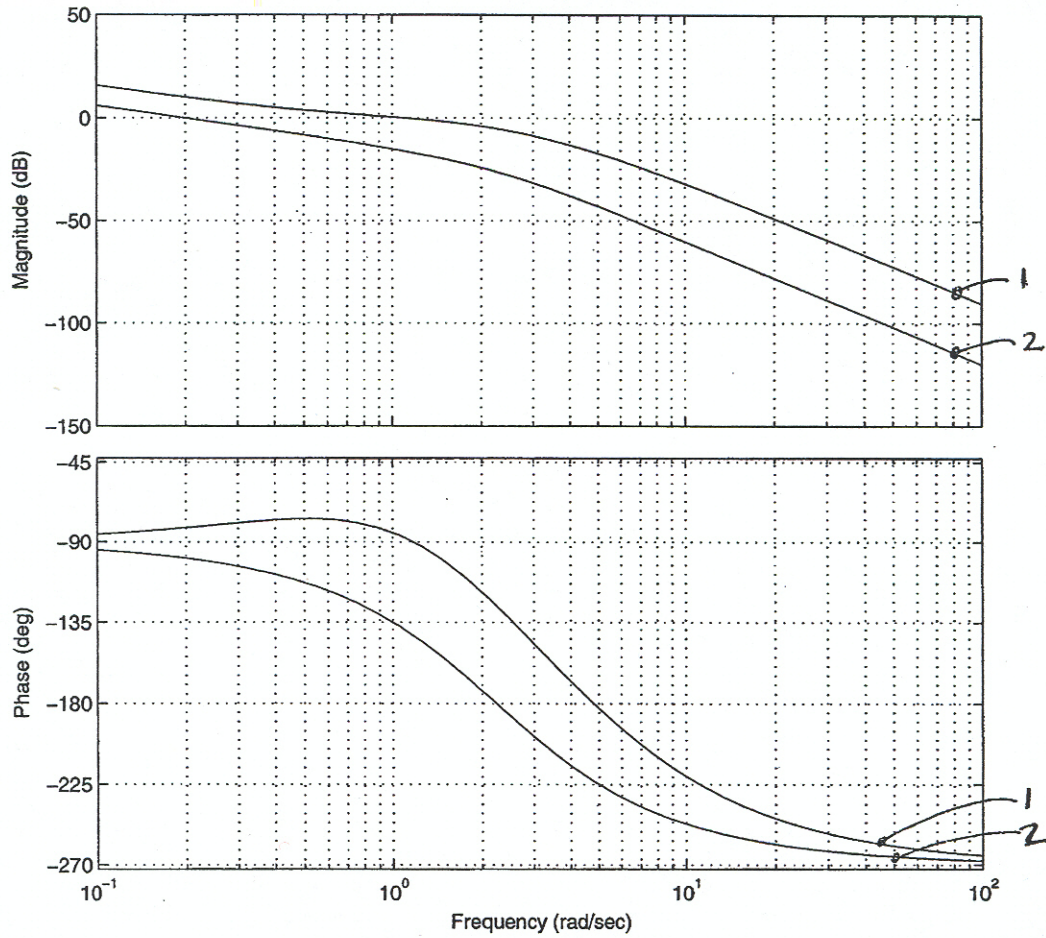
Justify your answers and indicate in the attached figure (page 5) the corresponding quantities.

END

NAME: _____

STUDENT NO.: _____

Bode Diagram



- 1. Compensated
- 2. Uncompensated