UNIVERSITY OF VICTORIA

FINAL EXAMINATIONS – DECEMBER 2007

ELEC 360 – CONTROL THEORY AND SYSTEMS I

SECTIONS F 01, F 02

O BE ANSWERED IN BOOKLETS

DURATION: 3 hours

INSTRUCTOR: Dr. P. Agathoklis

TUDENTS MUST COUNT THE NUMBER OF PAGES IN THIS EXAMINATION APER BEFORE BEGINNING TO WRITE, AND REPORT ANY DISCREPANCY MMEDIATELY TO THE INVIGILATOR.

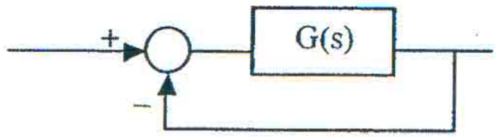
HIS QUESTION PAPER HAS 5 PAGES, INCLUDING THIS COVER PAGE AND WO ATTACHED FIGURES.

OUR (4) PAGES OF HANDWRITTEN NOTES AND PHOTOCOPIES OF LAPLACE RANSFORMS ARE PERMITTED.

ETACH PAGE 5 FROM THE EXAMINATION PAPER AND HAND IN VITH YOUR ANSWER BOOKLET.

Marks

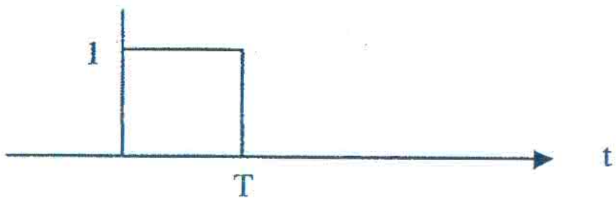
5) 1. Consider a system given by:



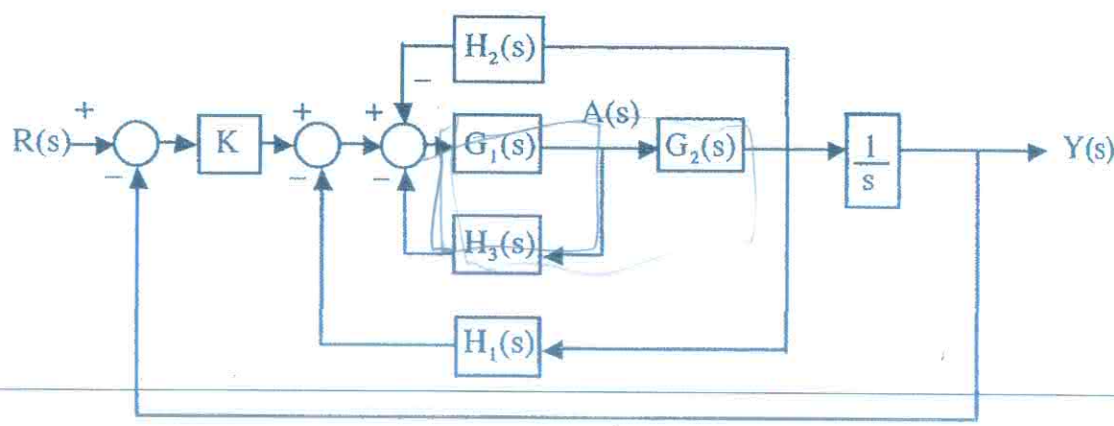
where G(s) has

- one integrator,
- one pole at -1
- a zero at -2 and
- a velocity error constant of 5

Find the response of the closed-loop system to an input signal given by:

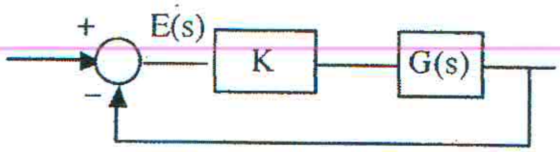


4) 2. Consider the system



Find the transfer function G(s)=Y(s)/R(s).

3. Consider the system given by:



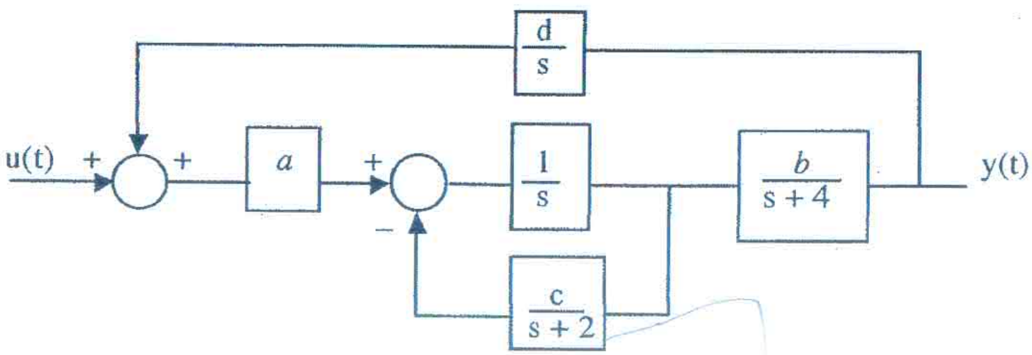
where $G(s) = \dfrac{K(s+1)}{s(s+2)(s+3)}$

a) Sketch the root-locus of the system for K between 0 and infinity.

b) Discuss the transient response performance of the closed-loop system when K goes from 0 to ∞.

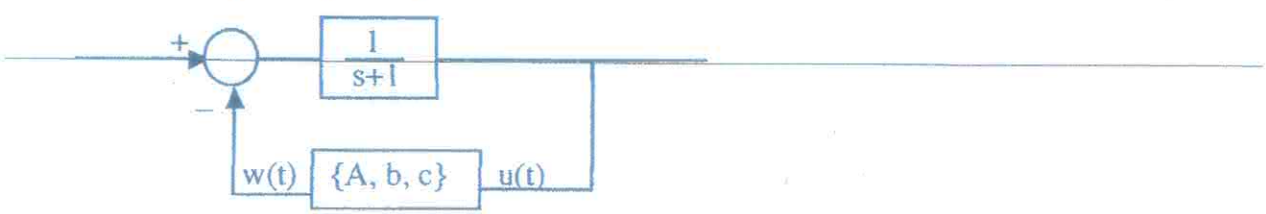
c) What is the value of the steady state error E(s) when the input is a unit step, a unit ramp, or a parabola?

4. Consider the system given by:



Find a state-space description for the system.

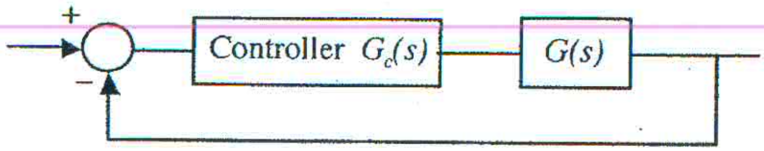
5. Consider a system given by



where $\underline{\dot{x}}(t) = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \underline{x}(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$

$w(t) = [K \quad 1]\underline{x}(t)$

7) 6. Consider the system



where $G(s) = \dfrac{1}{s(s-1)}$

(a) Sketch the Bode and Polar plots for G(s) and evaluate the stability of the closed-loop system with a Proportional Controller $G_c(s)=K$ using the Nyquist Stability Criterion

(b) Replace Proportional Control with Derivative control given by

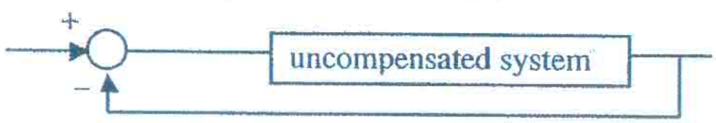
$$G_c(s) = K\,(s+2)$$

and use the Nyquist Stability Criterion to evaluate the stability of the closed-loop syst when K is changing from 0 to infinity.

5) 7. The Bode plots of the open loop compensated and uncompensated systems are given on 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 constar

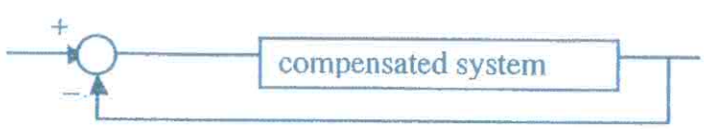
c) The phase and gain margins.

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.

Figure for Question 7

1. Uncompensated system (solid line)

2. Compensated system (dashed line)