UNIVERSITY OF VICTORIA

EXAMINATIONS DECEMBER 1998

ELEC 360 - CONTROL THEORY AND SYSTEMS: I

SECTION F01

TO BE ANSWERED IN BOOKLETS

TIME: 3 hours
INSTRUCTOR: P. Agathoklis

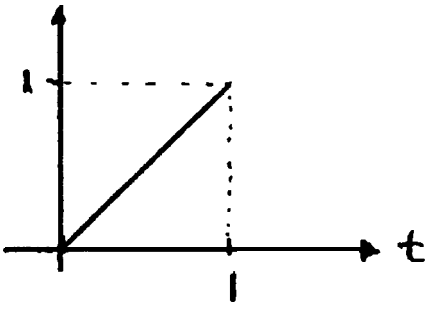
FOUR PAGES OF HANDWRITTEN NOTES AND PHOTOCOPIES OF LAPLACE TABLES ARE PERMITTED

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

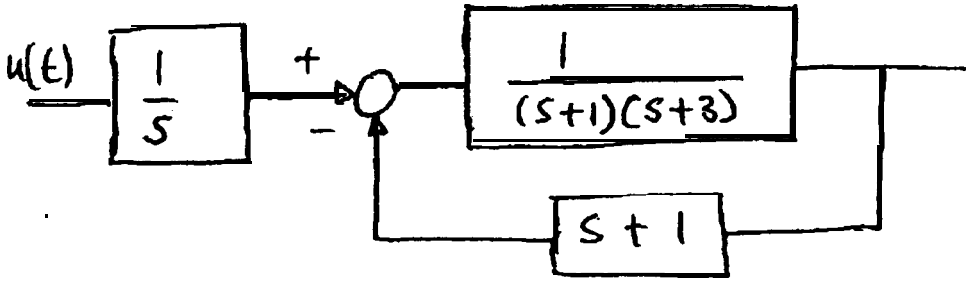
THIS QUESTION PAPER HAS SIX PAGES.

Marks

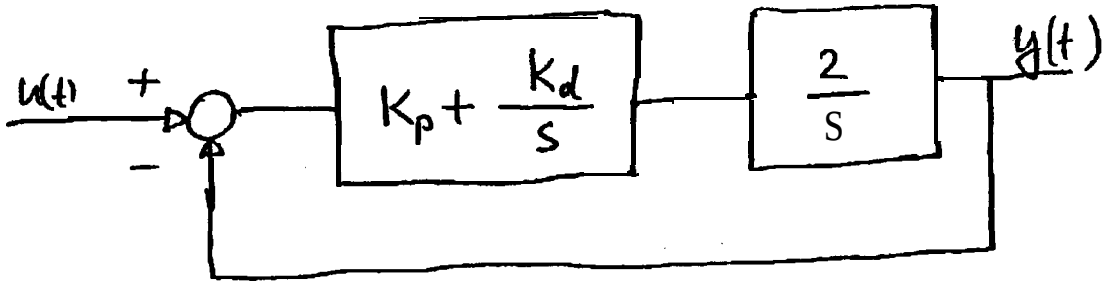
(3) 1. **Find the response** of a system with impulse response $g(t) = \exp(-3t)$ to an input **signal** given by



(3) 2. **Find a state-space description for a system given by**



(4) 3. Given a **system**



In a plane where K_p **is** the horizontal K_d the vertical axis indicate:

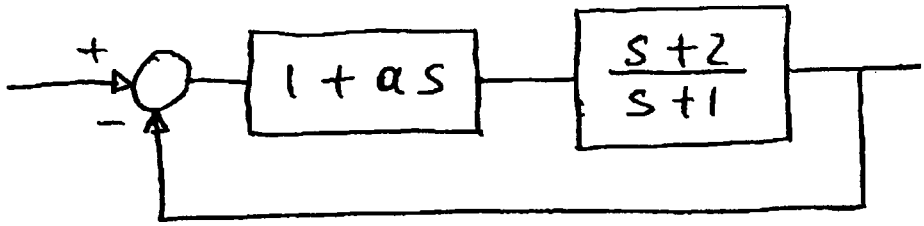
a) The region where **the** system is stable

b) The region where the system **has an underdamped response**

c) The region corresponding to **an** acceleration error coefficient of **less than 10.**

Marks

(4) 4. Consider the system



Sketch the location of the poles of the closed-loop system when the parameter *a* changes from 0 to infinity.

(4) 5. Sketch the root locus of

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

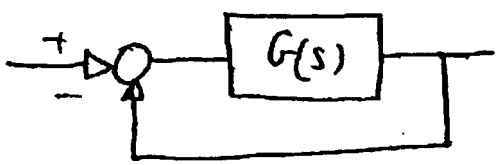
and discuss the effect of changing *K* between 0 and infinity on the step response of the closed-loop system.

(8) 6. Sketch the Bode and Nyquist plots for the following systems

a) $G(s) = \frac{K(s-1)}{s(s+1)}$

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

Analyse the stability of the corresponding closed-loop system,



for (a) and (b) using the Nyquist stability criterion.

Marks

(4) 7. **The Bode diagrams of** the **open-loop** transfer function is given in the **attached** sheet. Find **graphically**

- The type of **the** system
- **The phase** and **gain margins**
- The **phase and gain margins where the gain is increased 10** times.

Justify your answers by indicating in the figure **the corresponding quantities.**

(5) 8. **The Bode plots of** the **uncompensated and compensated system are given in the attached sheet. Assume that there are no poles or zeros for** $w < 0.001$ **and** $\omega > 100$. **Find graphically for both** systems:

- **The type of** system
- **The value of** the corresponding error coefficient
- **The phase and gain margins**

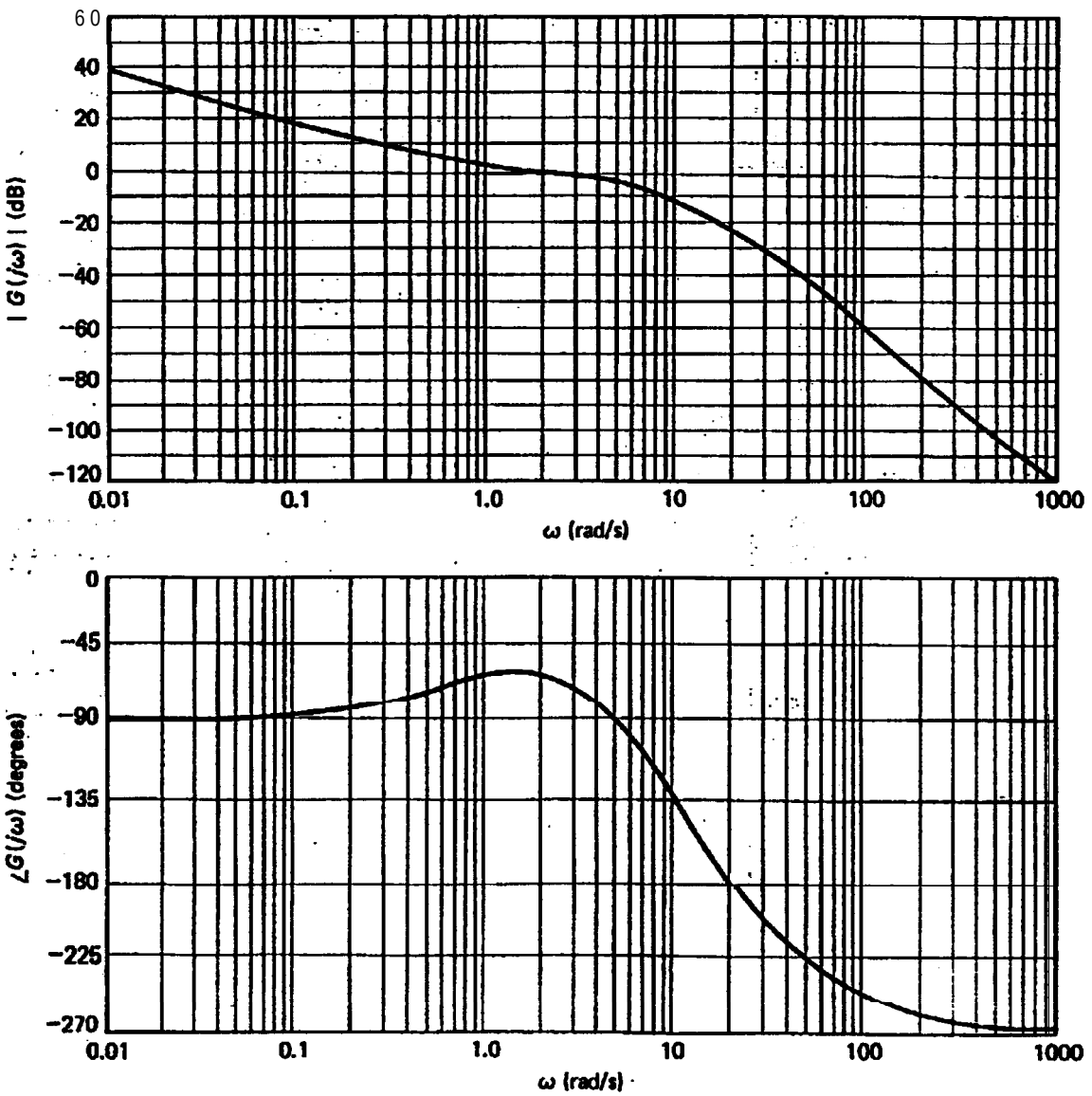
What compensator is used and what is its **effect on** the closed-loop system **response?**

Justify your **answers by indicating in the figure** the corresponding quantities.

WRITE your NAME **and** STUDENT **ID** NUMBER on **the attached sheets for Question 7 and 8. Include those sheets with your booklet.**

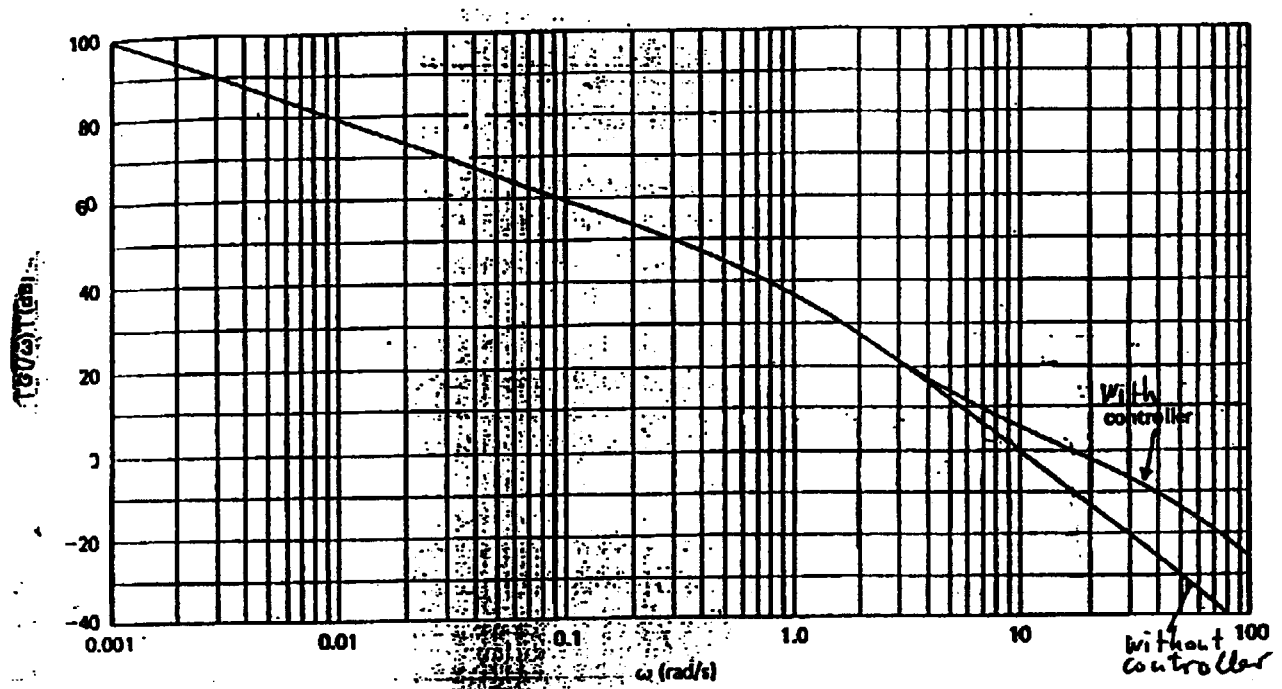
Quest ion 7

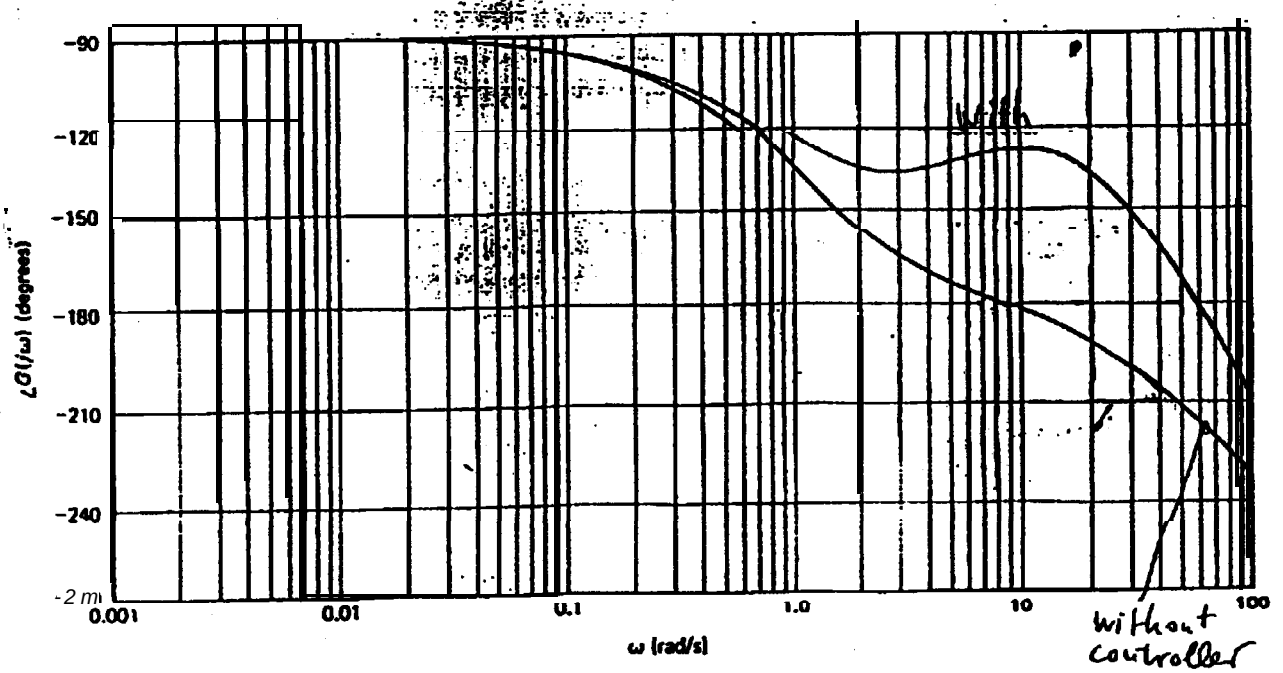
NAME:_____ **STUDENT ID:** _____



Question 8

NAME: _____ **STUDENT ID:** _____





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