THE UNIVERSITY OF ADELAIDE
DEPARTMENT OF MECHANICAL ENGINEERING

EXAMINATION FOR THE DEGREE OF BE

AUTOMATIC CONTROL 2003

NOVEMBER, 2002

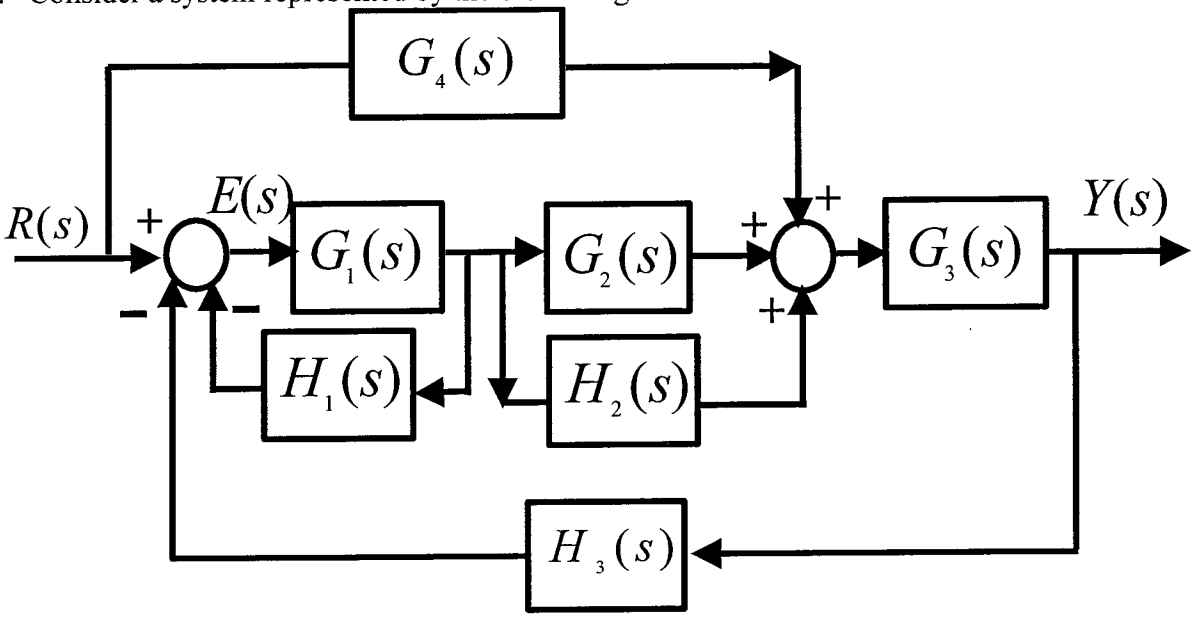
TIME: 2 HOURS

[In addition, candidates are allowed ten minutes before the examination begins to read the paper.]
[The use of notes, textbooks and calculating devices other than computers is permitted in the examination room.]
[Graph paper is provided.]

Empl ID:_____First Name:_____Last Name:_____Score:

10 points per question and 70 in total.

1. Consider a system represented by the block diagram:



Find the closed-loop transfer function T(s)=Y(s)/ R(s).

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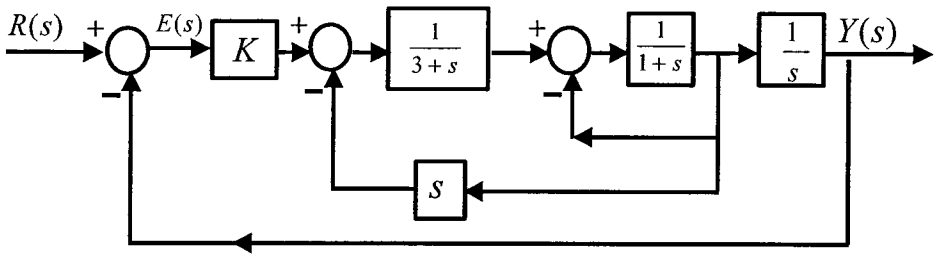
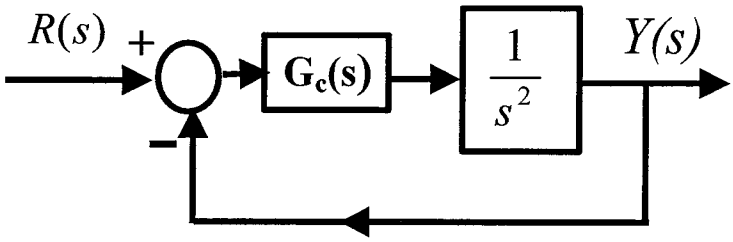
2. Consider the following closed-loop control system



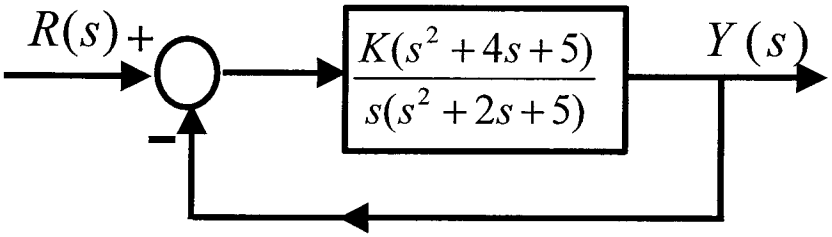
(i) Indicate the system type of the system.
(ii) Find the value of K that yields a steady-state error equal to 0.3 for a unit ramp input.

3. Consider a space vehicle model depicted in the block diagram.



Design a phase-lead compensator $G_c(s)$ such that the closed-loop compensated system has a time constant τ=0.5 s and a damping ratio ζ=0.707. The compensator has a dc gain as 8/3.

4. Consider the feedback system



(i). Determine the approximate angles of departure of the root-locus from the complex poles.
(ii). Determine the approximate arrival angles of the root-locus at the complex zeros.

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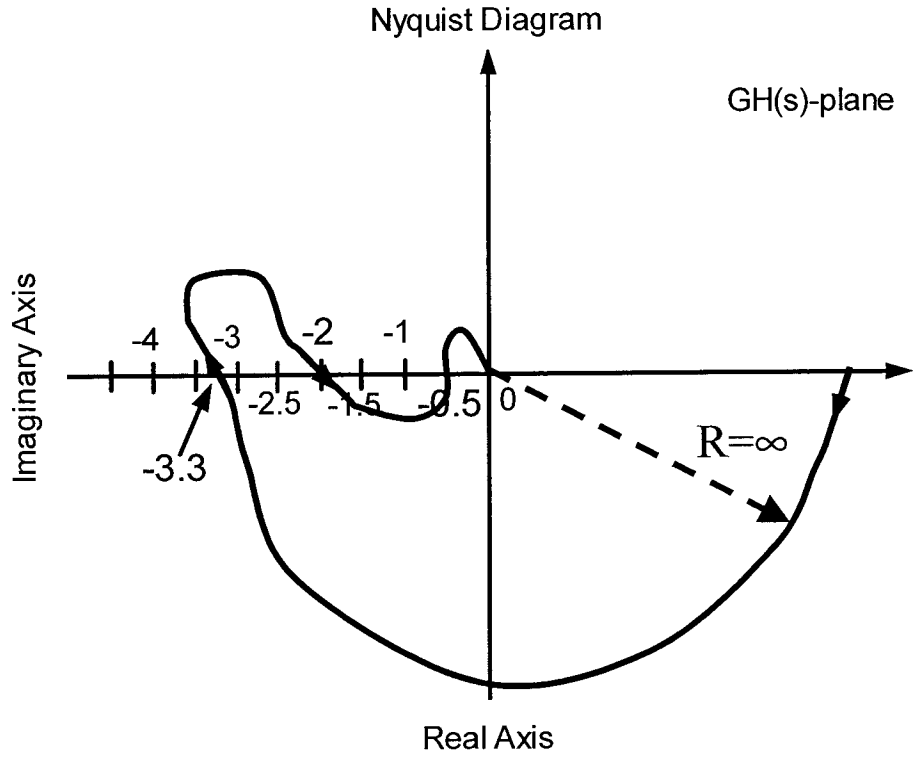
5. The Nyquist diagram (only for the frequency range $0^{+}<\omega<+\infty$) of a feedback control system is shown below. Assume that GH(s) has no poles in the right-hand s-plane. A gain K is cascaded with GH(s). Find the range of K for which the system is stable.



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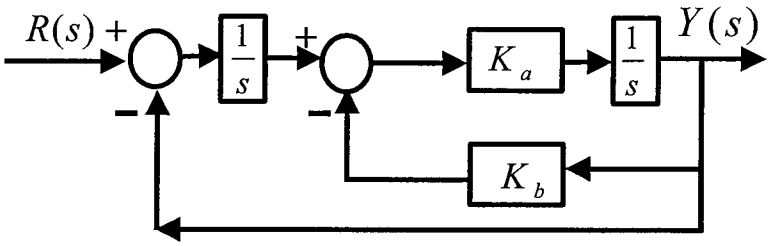
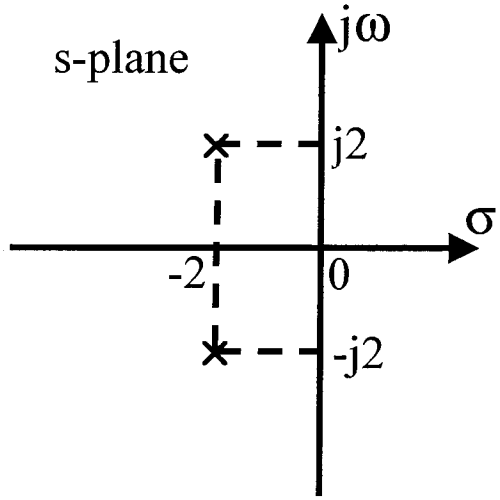
6. A feedback control system is shown as follows:



A design specification is that the closed-loop poles of the system are located at the following given positions in the s-plane.

(i) Find the settling time T_s (four times of the time constant) and the percent overshoot Mo of the system;

(ii) Design the values of K_a and K_b such that the specification can be met.



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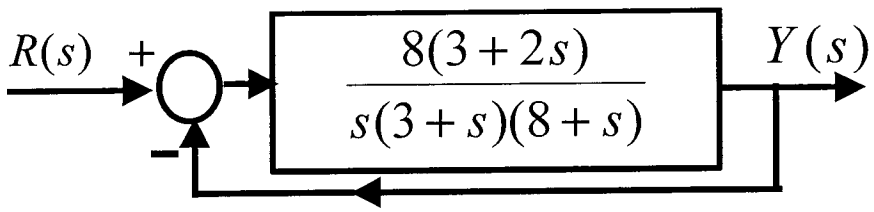
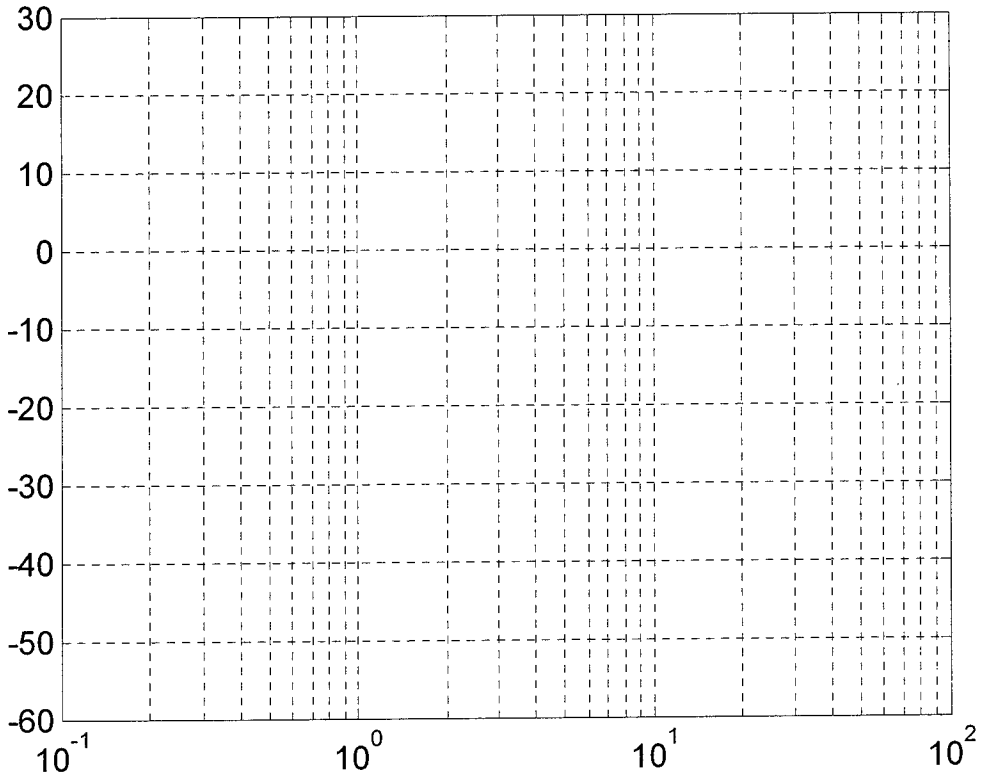
7. Draw the Bode log-magnitude plot of G(s) for the system shown below.



(You must draw your log-magnitude plot on this or next page and hand in this question pamphlet together with your answer sheets).



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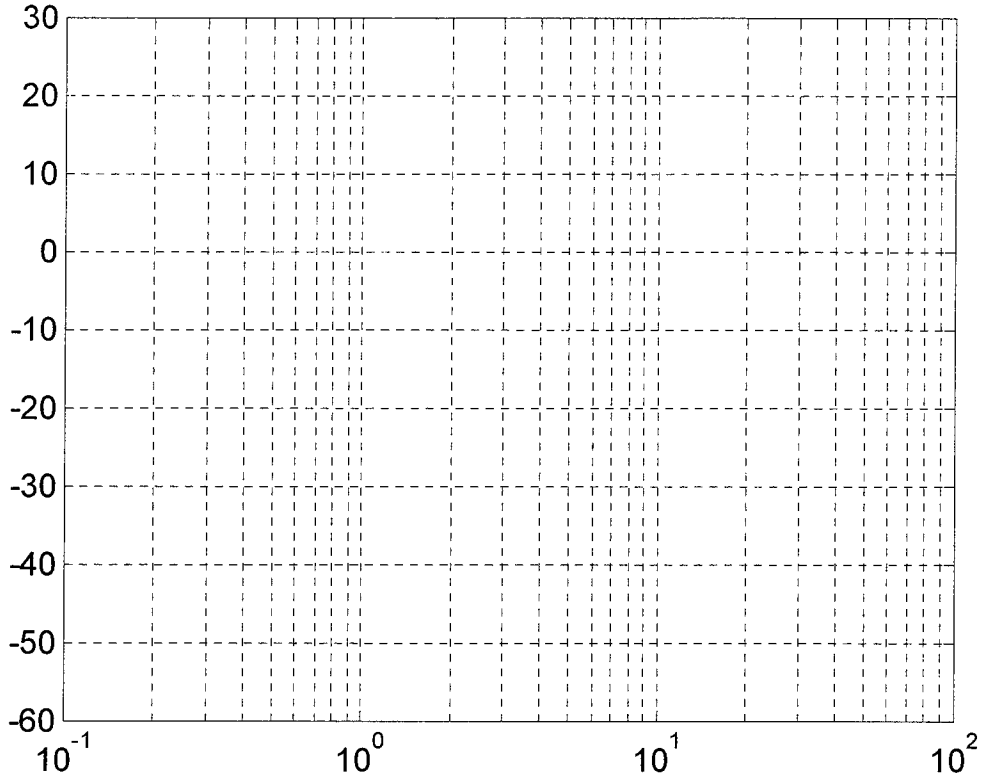
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-40
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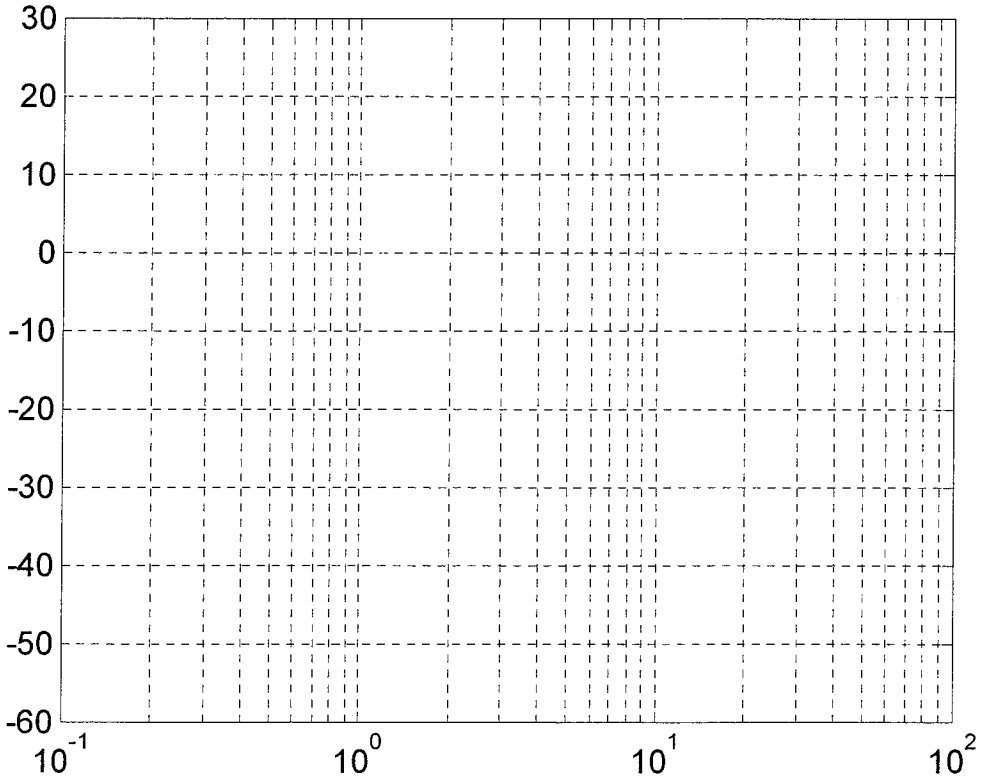
10^1
10^2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