جامعة بيرزيت
BIRZEIT UNIVERSITY

Faculty of Engineering and Technology
Department of Mechanical and Mechatronics Engineering
Second Examination – Spring 2017

ENME 438: Control Theory
Date of Examination: 7/5/2017
Instructor: Eng. Sima Rishmawi

Student ID: _____
Time duration: 75 minutes
Total Marks: 100

This exam contains 6 pages (including this cover page) and 5 problems. Check to see if any pages are missing. Enter your Student ID number on the top of this page, and at the bottom of each page.

You may *not* use your books, notes, or any other reference on this exam, except for a two-sided A4 cheat sheet (to be handed in with your exam). You can use your own calculator only. Borrowing calculators is not allowed.

You are required to show your work on each problem on this exam.
Do not write in the table to the right.

Problem	Points	Score
1	25	
2	20	
3	25	
4	15	
5	15	
Total:	100	

1) If a second-order system has a percentage overshoot of $\%OS = 12\%$ and a settling time of 0.6 s. Calculate the following:

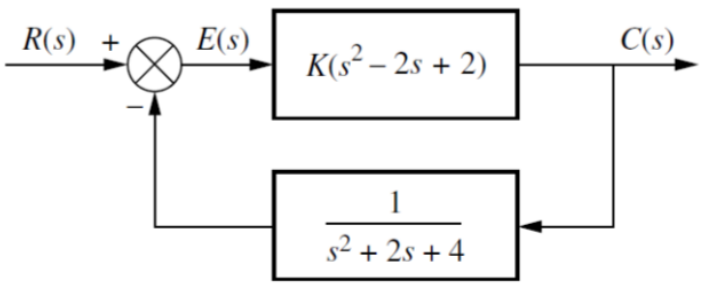
(a) The two poles of the system

(b) The peak time

(c) The rise time

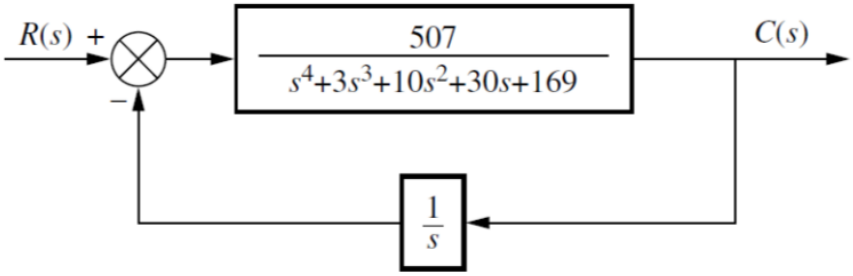
25 marks

2) Use the Routh-Hurwitz criterion to find the range of values of K for which the system shown in the Figure is stable.



20 marks

3) Using the Routh-Hurwitz criterion, tell how many closed-loop poles of the system shown in the Figure lie in the left half-plane, in the right half-plane, and on the $j\omega$-axis. Also comment on the system's stability.



25 marks

4) Consider a unity feedback control system with the closed-loop transfer function:

$$\frac{C(s)}{R(s)} = \frac{Ks + b}{s^2 + as + b}$$

(a) Find the open loop transfer function G(s).

(b) Prove that the steady-state error for a unit-ramp input is given by:

$$e_{ss} = \frac{a - K}{b}$$

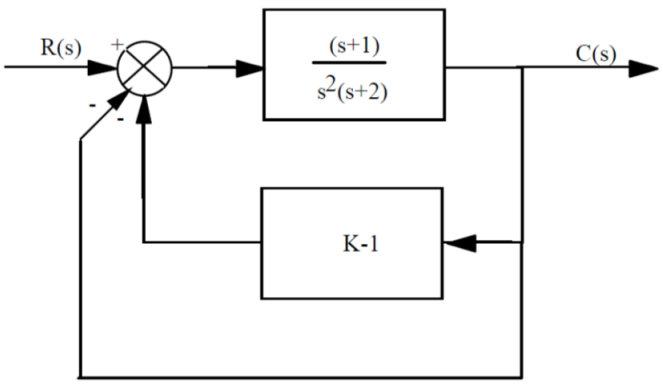
15 marks

5) For the system shown in the Figure find the following:

(a) What is the system type?

(b) What is the value of K to yield 0.1% error in the steady state?

(c) Does the value of K calculated in (b) ensure stability? Explain.



15 marks