AMERICAN UINVERSITY OF BEIRUT
FACULTY OF ENGINEERING AND ARCHITECTURE
EECE 460 Control Systems
Spring 2006-2007
Quiz II

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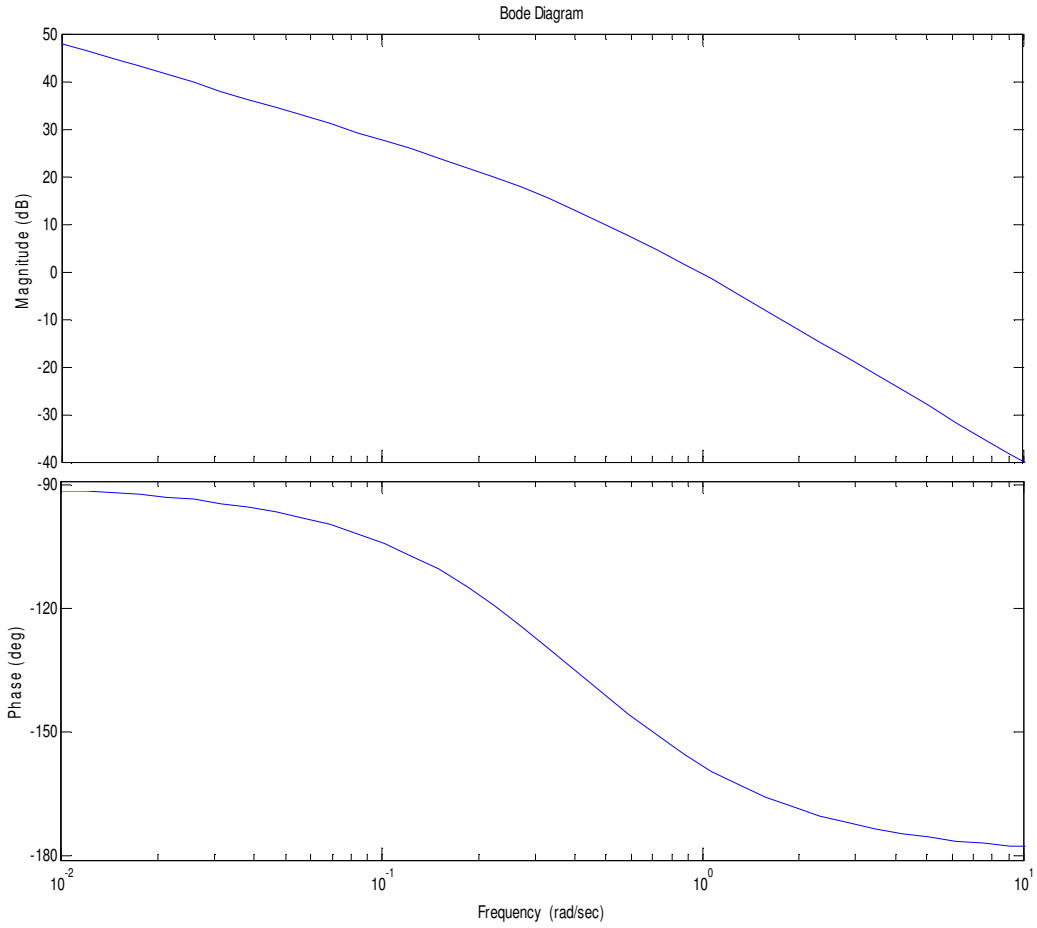
1.5 hours. May 3, 2007
Total of 100 points; Open Book Exam, 2 pages
YOU MUST RETURN THIS EXAM WITH YOUR ANSWER BOOKLET

No Questions during exam, state assumptions & proceed.

Problem 1 (60 points):

For the unity feedback system, and supplied open loop Bode Plots:



a) Approximate the open loop transfer function based on the exact Bode plots supplied
b) Is the open loop system stable?
c) Approximate the static velocity error constant.
d) Supply Closed Loop Transfer Function Phase and Gain Margins.
e) Is the closed loop system stable?
f) Propose a compensator type to control the system and deliver a controlled system desired phase margin of at least 45 deg and Gain Margin of at least 30 db while maintaining the same static velocity error constant of the uncontrolled system, justify your choice.
g) Design your proposal of part (f) as transfer function in (s)

Problem 2 (40 points):

For the unity feedback system with series P controller of positive gain K(can very between 0 and infinity) and open loop transfer function:

$$G(s) = \frac{(s^2 + 4)}{s(s + 4)}$$

a) Locate on the s-plane poles and zeros of open loop transfer function, is that system stable?
b) For the gain K almost zero, what are the values of poles of the corresponding closed loop system?
c) As K is increased positively from zero, give the range of pure real poles of the closed loop transfer function.
d) What is the value of K that makes the closed loop system critically damped (double pole)?
e) As K increases infinitely, where do the closed loop transfer function poles converge to?
f) What is the range of K that makes the controlled closed loop system underdamped?
g) Based on parts (a through f), approximate graphically the root locus of the closed loop transfer function.