Name:
ID. No.

Eskişehir Osmangazi University - Electrical Engineering Department
Fundamentals of Control Systems- Final Examination - Spring 2015

Duration: 70 minutes; **Allowed**: An A4 size two sided formula sheet and a calculator; **Directions**: All answers must be written below the questions. Anything written elsewhere won't be graded. Use the back side of the exam sheet if you need scratch paper.

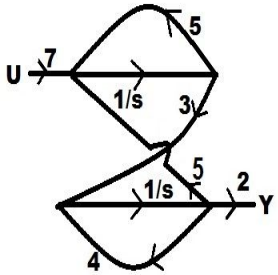
Question 1.

25 pts. Bode diagram of an LTI system of the form $\frac{1}{s^2+as+b}$*, where* a *and* b *are real constants, is given on the back side of this sheet. (5 pts.) Is this system stable? (20 pts.) Find the steady state response of this system to the input* $2\sin(10t)$.

(a) Stable *(b)* $0.02\sin(10t-2.88)$

Reasoning: At w=10 gain and angle readings are -40 dB and -165 degree. So, gain is 0.01 and angle is -2.88 rads.(Reasoning is not required, this is for teaching purpose)

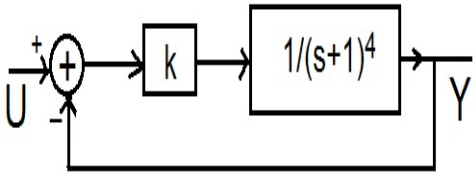
Question 2.



25 pts. Given the LTI systems with their transfer functions on the left write the transfer function $\frac{Y(s)}{U(s)}$.

$\frac{Y(s)}{U(s)} = \frac{42}{s^2-9s+5}$

Question 3.

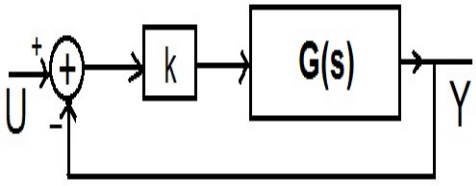


25 pts.Consider the configuration on the left and let k *be a positive constant gain. For which positive* k *values, is the system on the left BIBO stable.*

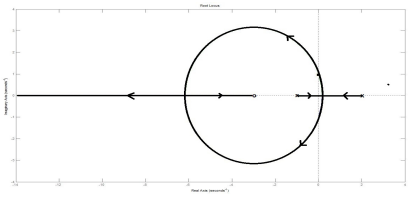
$k < 4$

Reasoning: Routh table for the closed loop tf denominator reveals this answer. (Reasoning is not required, this is for teaching purpose)

Question 4.



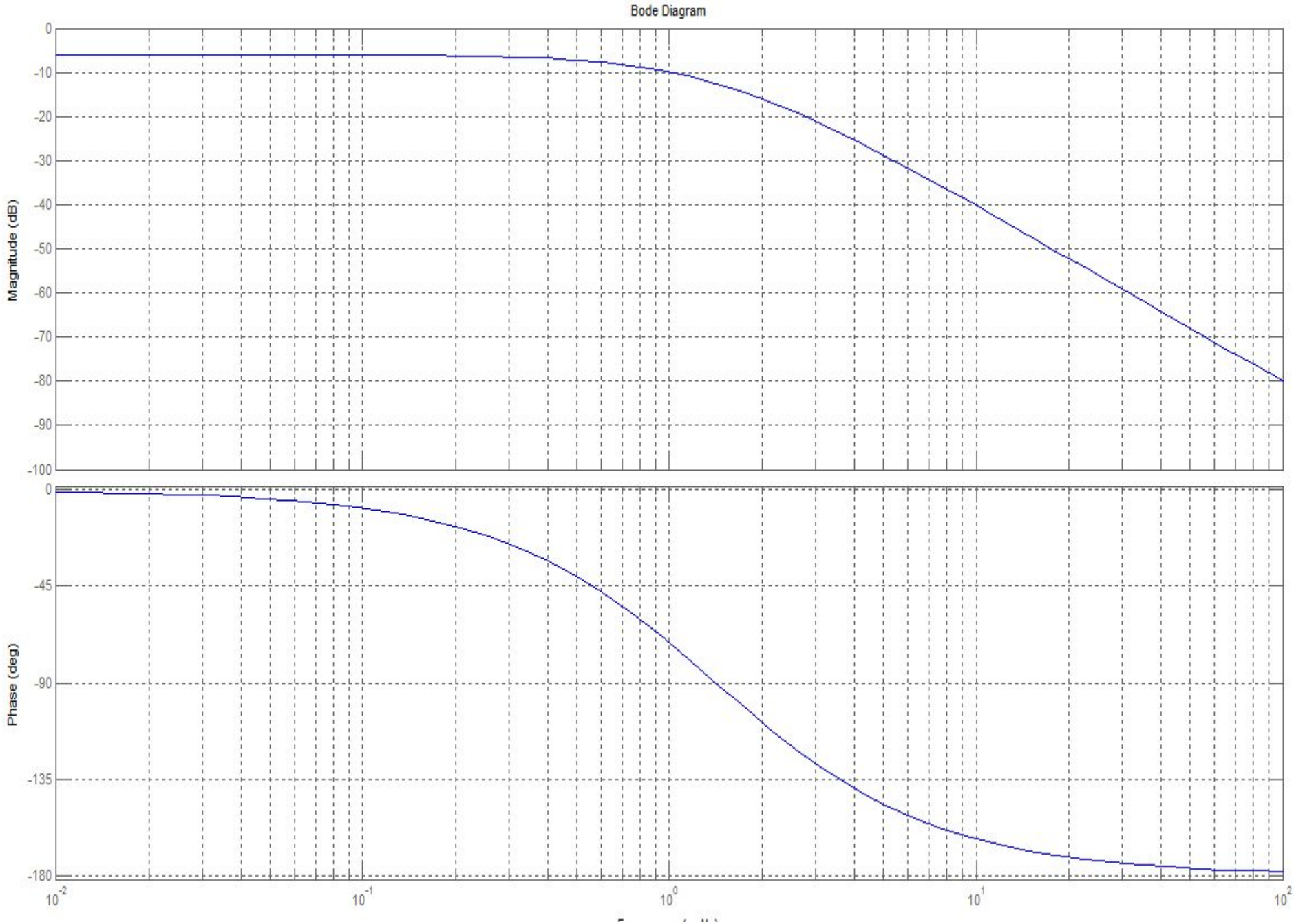
25 pts. For the configuration on the left let $G(s) = \frac{s+3}{s^2-s-2}$ *and let* k *be a positive constant gain. Sketch the root locus. For which positive* k *values, is the system BIBO stable.*



(b) $k > 1$

Reasoning: For the stability, closed loop system's denominator (which is 2nd degree) must have positive coefficients. It happens if $k > 1$. *(Reasoning is not required, this is for teaching purpose)*

Good Luck
A. Karamancıoğlu


Bode Diagram
Magnitude (dB)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Phase (deg)
0
-45
-90
-135
-180
10^-2
10^-1
10^0
10^1
10^2