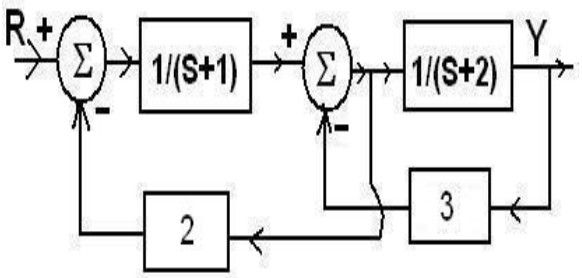
Name: ...
Id No.: ...

Eskişehir Osmangazi University - Electrical Engineering Department
Fundamentals of Control Systems
Final Examination - Summer 2013

For each question, put only the answer just below or next to it.

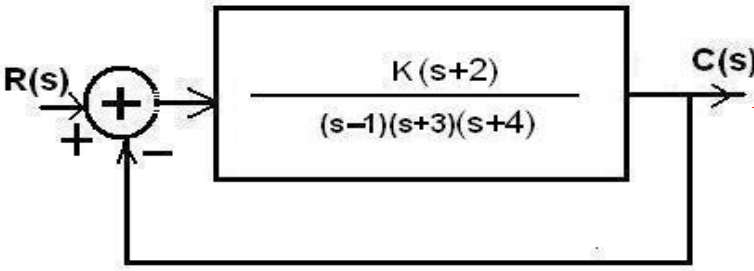
1. For the figure below, find the polynomials $n(s)$ and $d(s)$ such that the transfer function from R to Y is $\frac{n(s)}{d(s)}$.



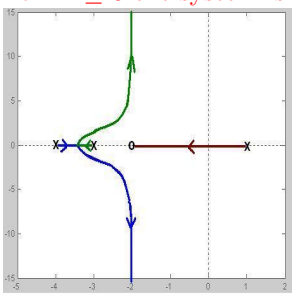
$n(s) = 1$

$d(s) = s^2 + 8s + 9$

2. For the figure below, sketch the root locus. Find all positive K values that make the closed loop system unstable.



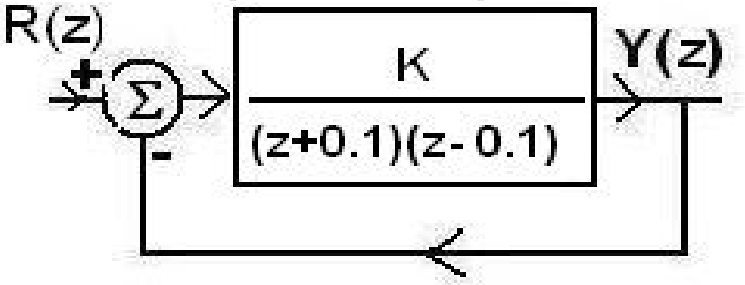
Ans. For $K \leq 6$ the system is unstable



3. For the figure below,
(a) find the transfer function $\frac{Y(z)}{R(z)}$, and

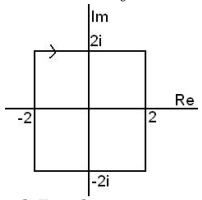
(b) find all positive K values that make the closed loop system unstable, and

(c) find steady state response of the system for $K = 0.5$ and R equals discrete unit step function.



(a) $\frac{K}{z^2+K-0.01}$
(b) For $K \geq 1.01$ the system is unstable.
(c) Because the system is stable for $K = 0.5$, we have $y(\infty) = \lim_{z\to 1}(z-1)\frac{z}{z-1}\frac{0.5}{z^2+0.5-0.01} = \frac{0.5}{1.49} = 0.3356$

4. [No partial credits] Consider the polynomial $p(s) = s^2 + 2s + 3$. As s travels once in the clockwise direction along the square path given below
(a) how many times does $p(s)$ encircle the origin in the clockwise direction? 2
(b) How many roots does $p(s)$ have in the square region (boundaries included)? 2



Good Luck,
A. Karamancıoğlu