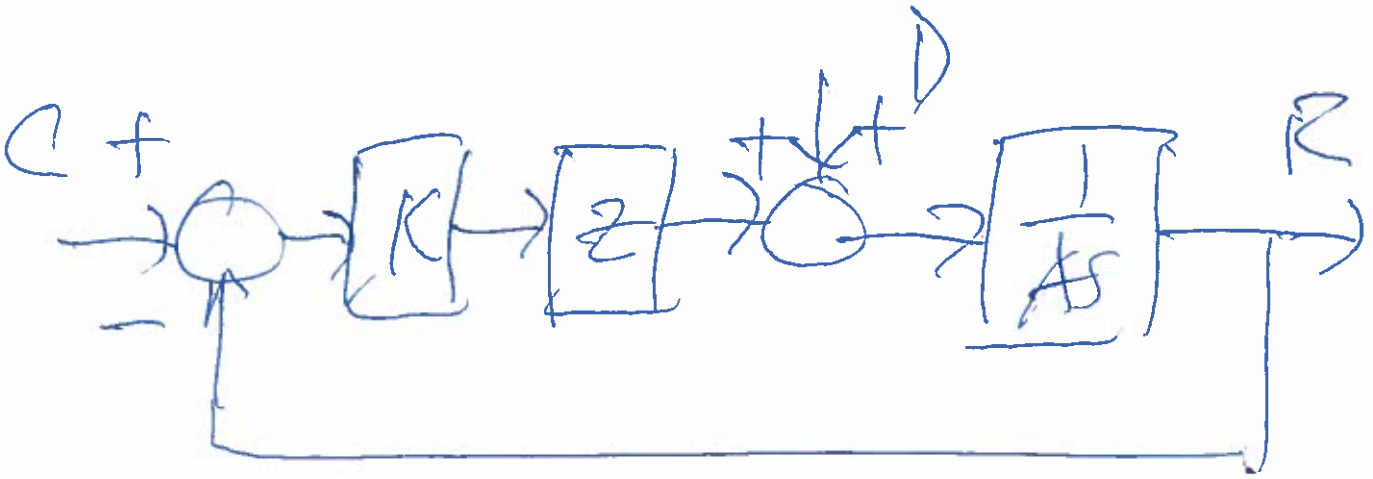
HYDRAULIC ACTUATOR

OVERALL BLOCK DIAGRAM



GH FUNCTION

$$GH = \frac{KZ}{AS}$$

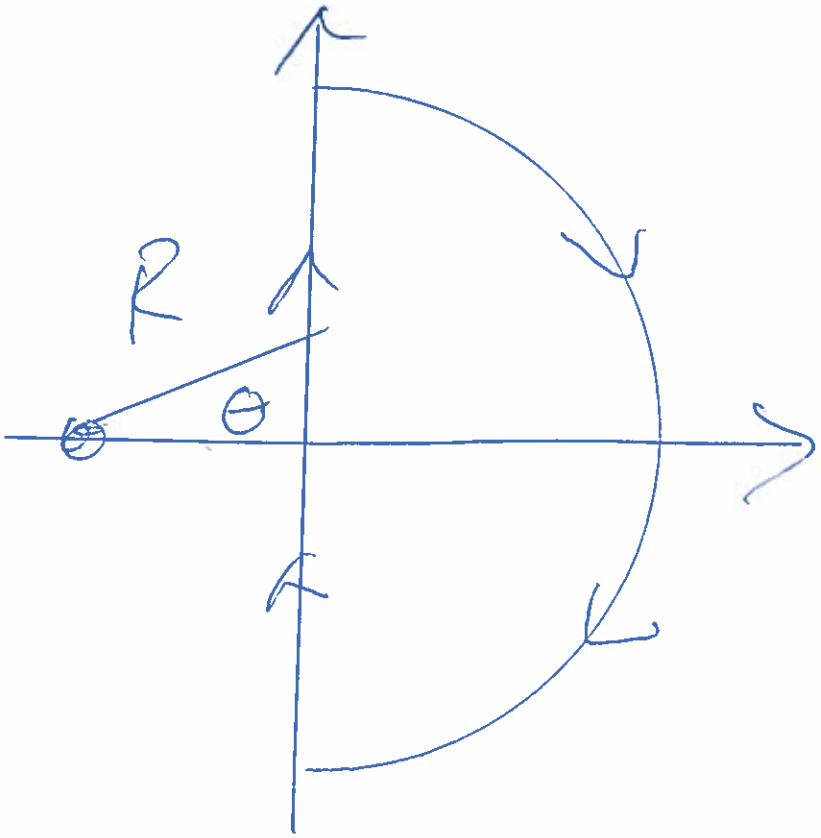
CHARACTERISTIC EQUATION

$$AS + KZ = 0$$

STABLE $K > 0$ UNSTABLE $K < 0$

GH PLOT

POSITIVE K



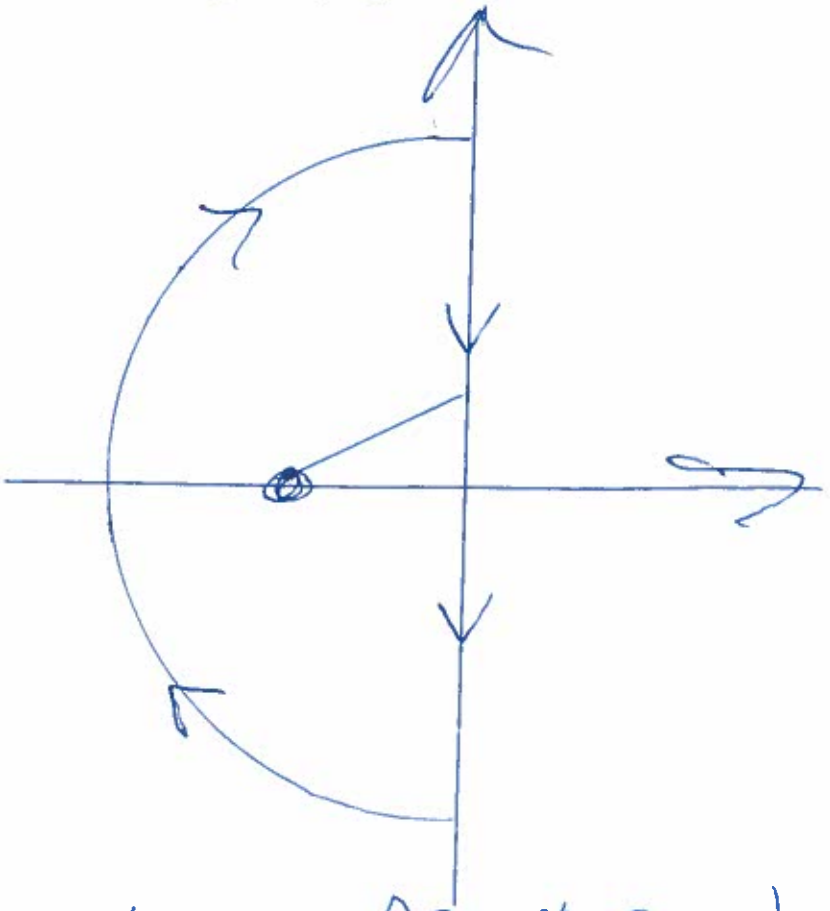
INTERPRETATION

$N_p = 0$ $N = 0$

$N_z = 0$ STABLE

GH PLOT

NEGATIVE K



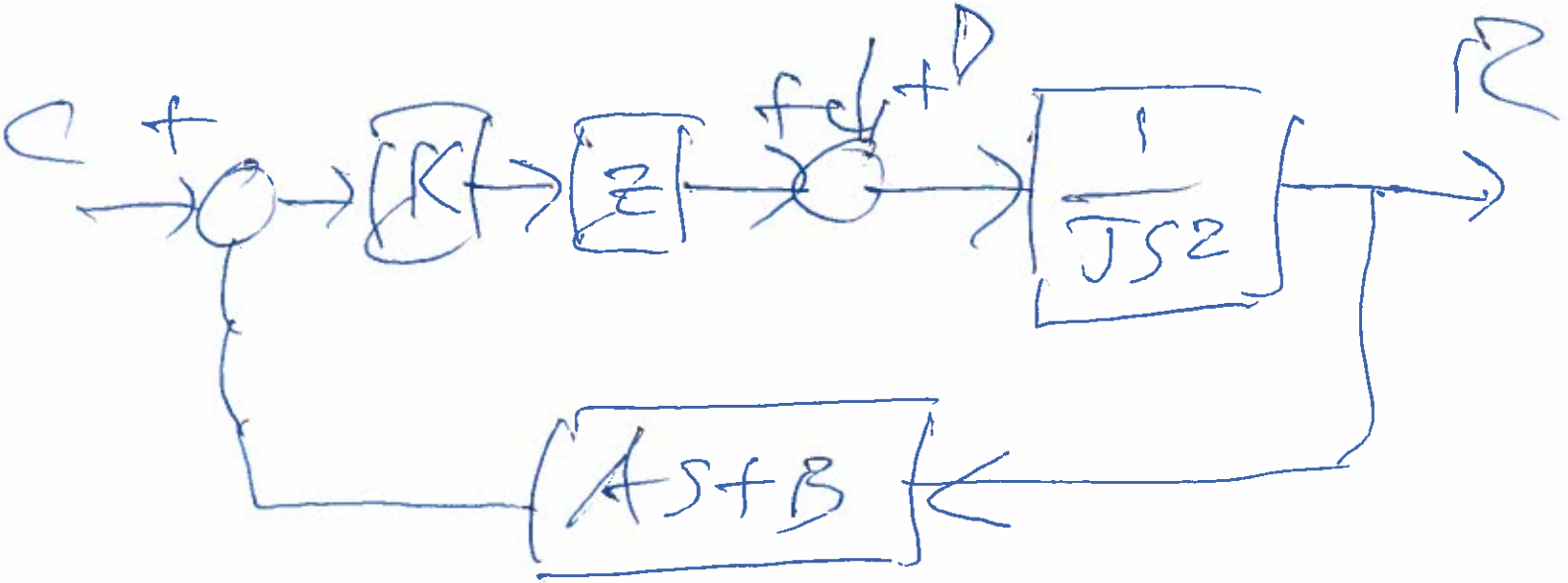
INTERPRETATION

$N_p = 0$ $N = 1$

$N_z = 1$ UNSTABLE

SATELLITE

OVERALL BLOCK DIAGRAM



GH FUNCTION

$$GH = \frac{K_2 (AS+B)}{JS^2}$$

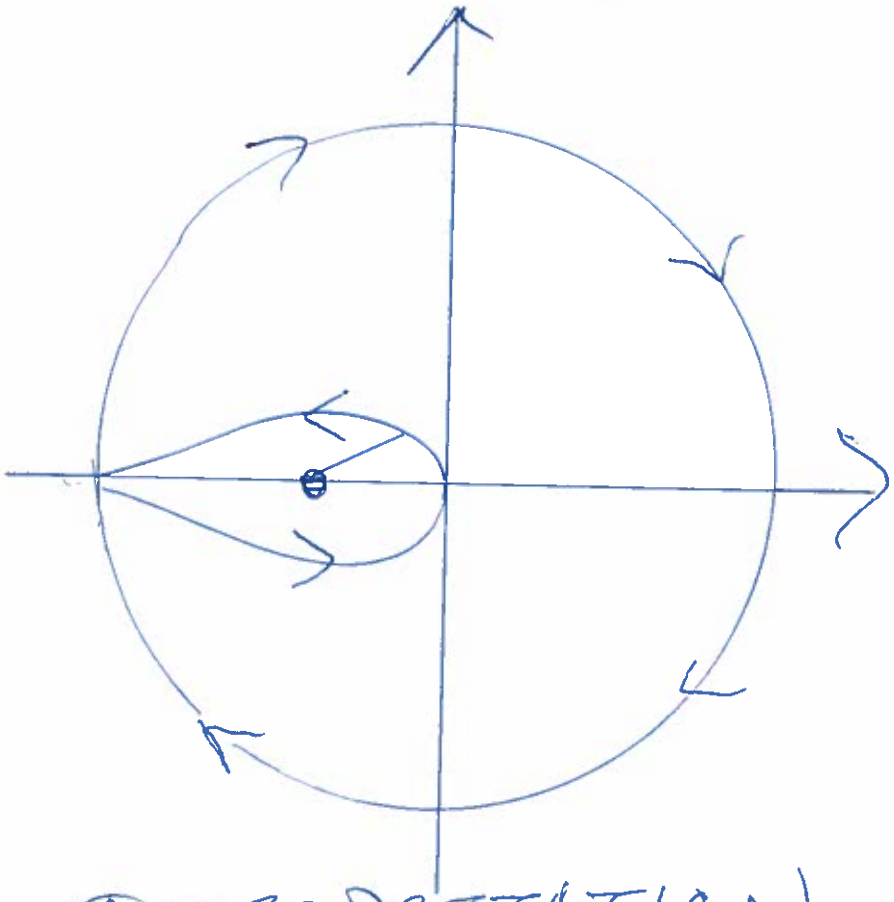
CHARACTERISTIC EQUATION

$$JS^2 + K_2 (AS+B) = 0$$

STABLE $K > 0$ UNSTABLE $K < 0$

GH PLOT

POSITIVE K



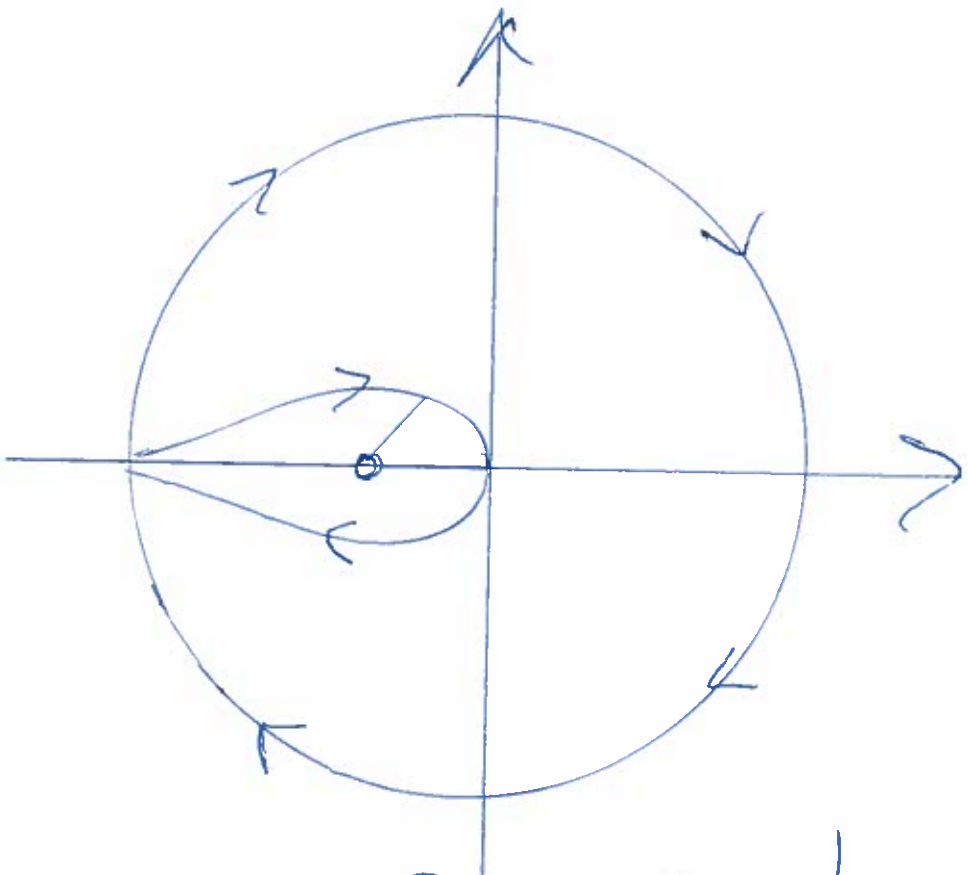
INTERPRETATION

$N_p = 0$ $N = 0$

$N_z = 0$ STABLE

GH PLOT

NEGATIVE K



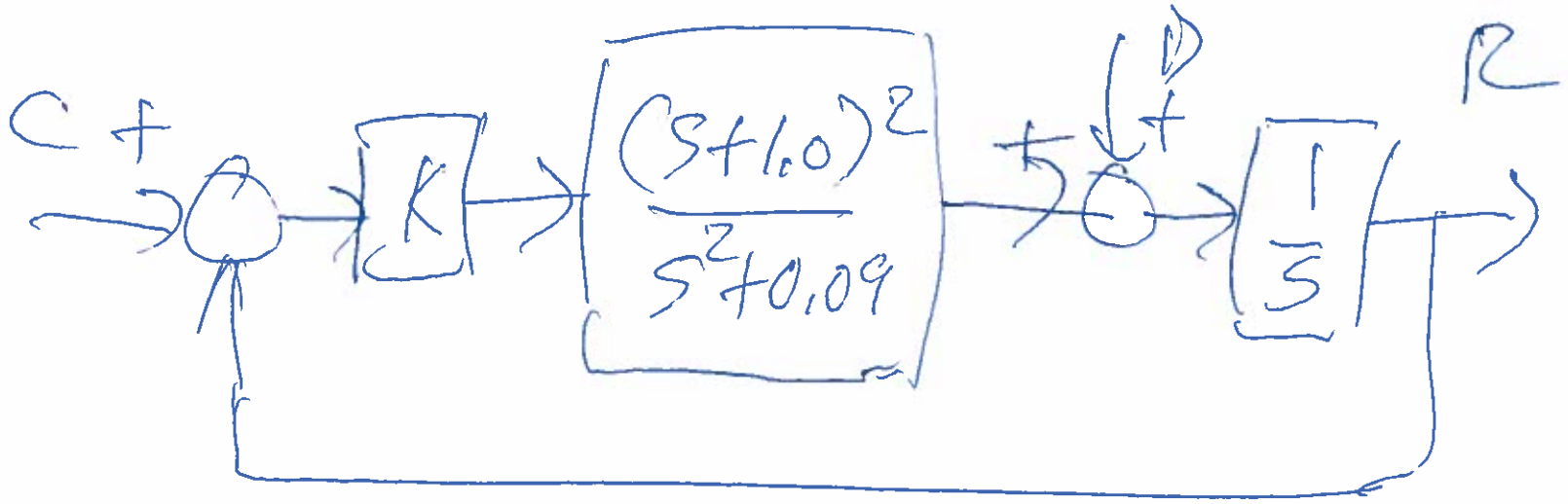
INTERPRETATION

$N_p = 0$ $N = 2$

$N_z = 2$ UNSTABLE

SUBMARINE DEPTH CONTROL

OVERALL BLOCK DIAGRAM



GH FUNCTION

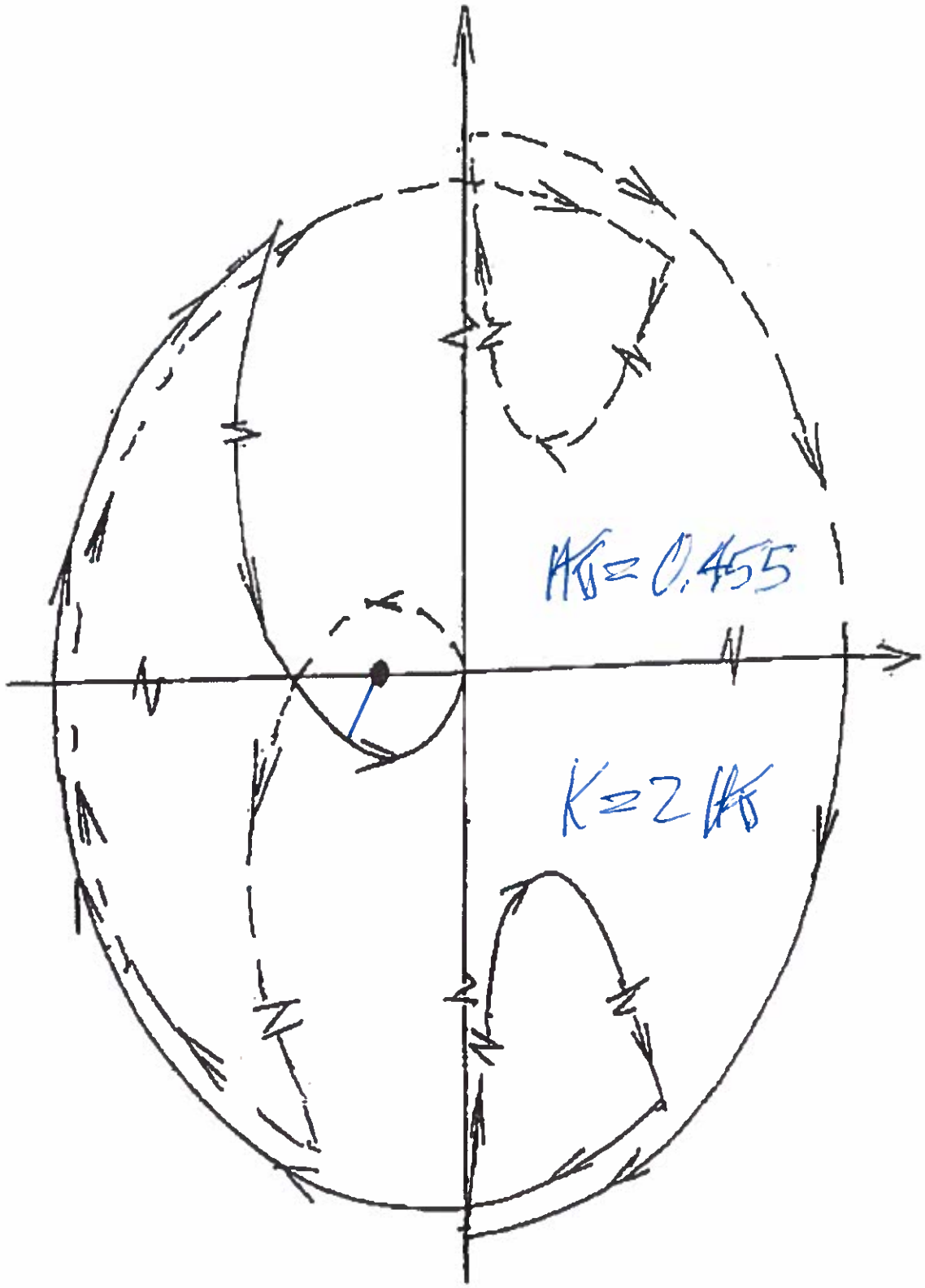
$$G(s) = \frac{K(s+1)^2}{s(s^2+0.09)}$$

$$= \frac{K(s^2+2s+1)}{s(s^2+0.09)}$$

GH POLES

$s = 0 \qquad s = +0.5j \qquad s = -0.5j$

UNSTABLE POLES $N_p = 0$


$\zeta = 0.455$
$K = 2$

INTERPRETATION

NET CLOCKWISE ROTATIONS

$N = -(+1) = 0$

UNSTABLE POLES

$N_p = 0$

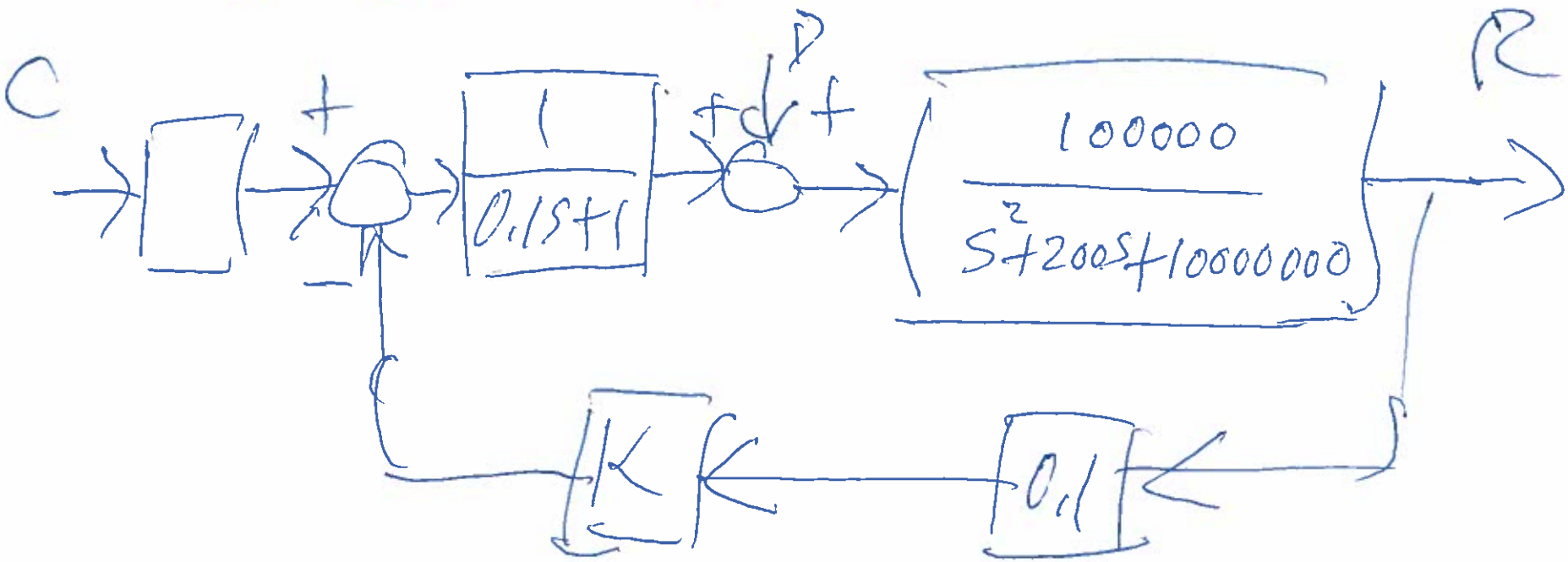
UNSTABLE ZEROS

$N_Z = N + N_p = 0 + 0 = 0$

STABLE

SPEECH CONTROL

OVERALL BLOCK DIAGRAM



GH FUNCTION

$$GH = \frac{0.1K100000}{(0.1S+1)(S^2+200S+10000000)}$$

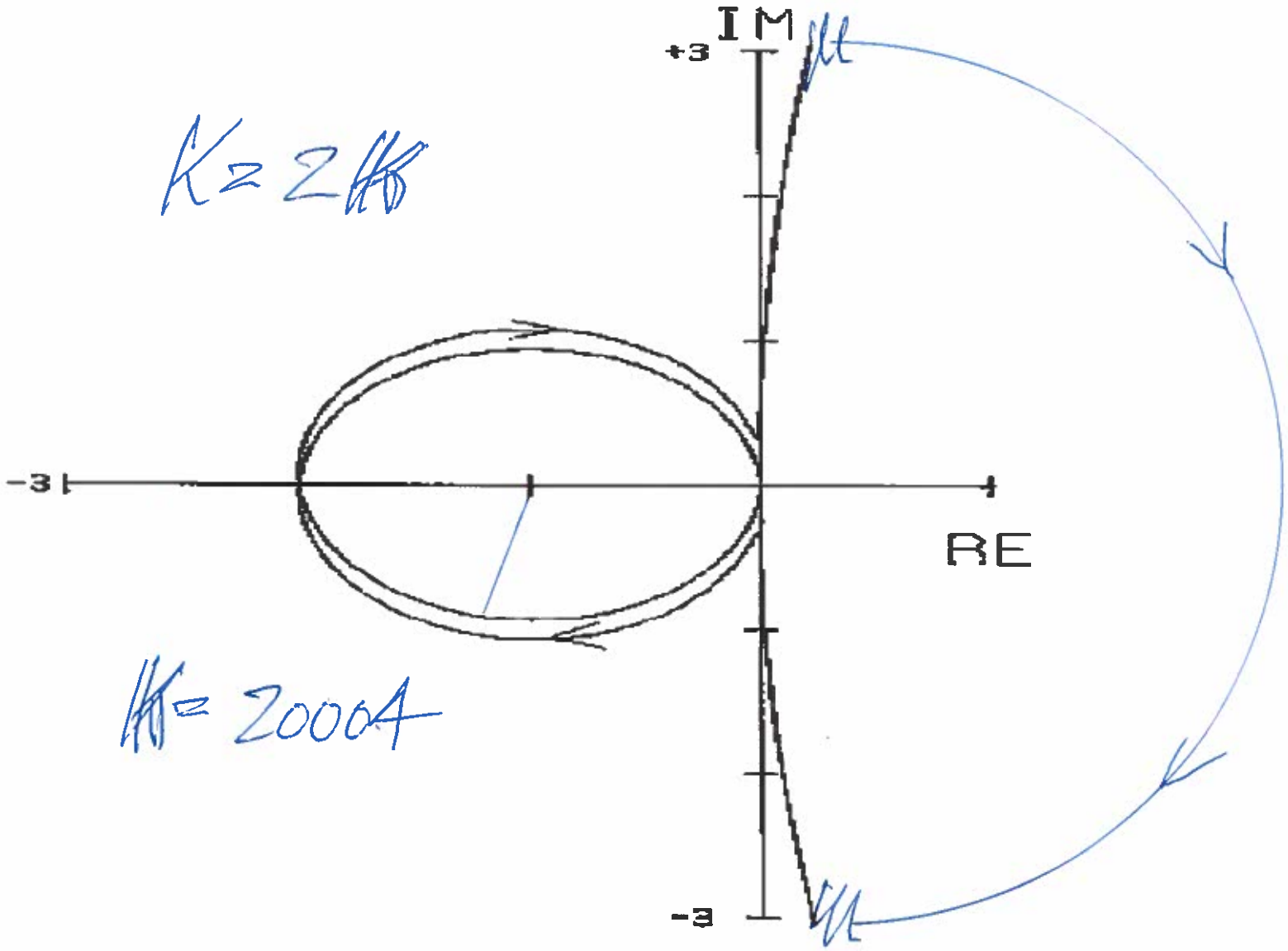
GH POLES

$$S = -10$$

$$S = -100 + 316(j)$$

$$S = -100 - 316(j)$$

UNSTABLE POLES $N_p = 0$


IM
+3
-3
-3
RE
K=2
K=200

INTERPRETATION

NET CLOCKWISE ROTATIONS

$N = +1+1 = 2$

UNSTABLE POLES

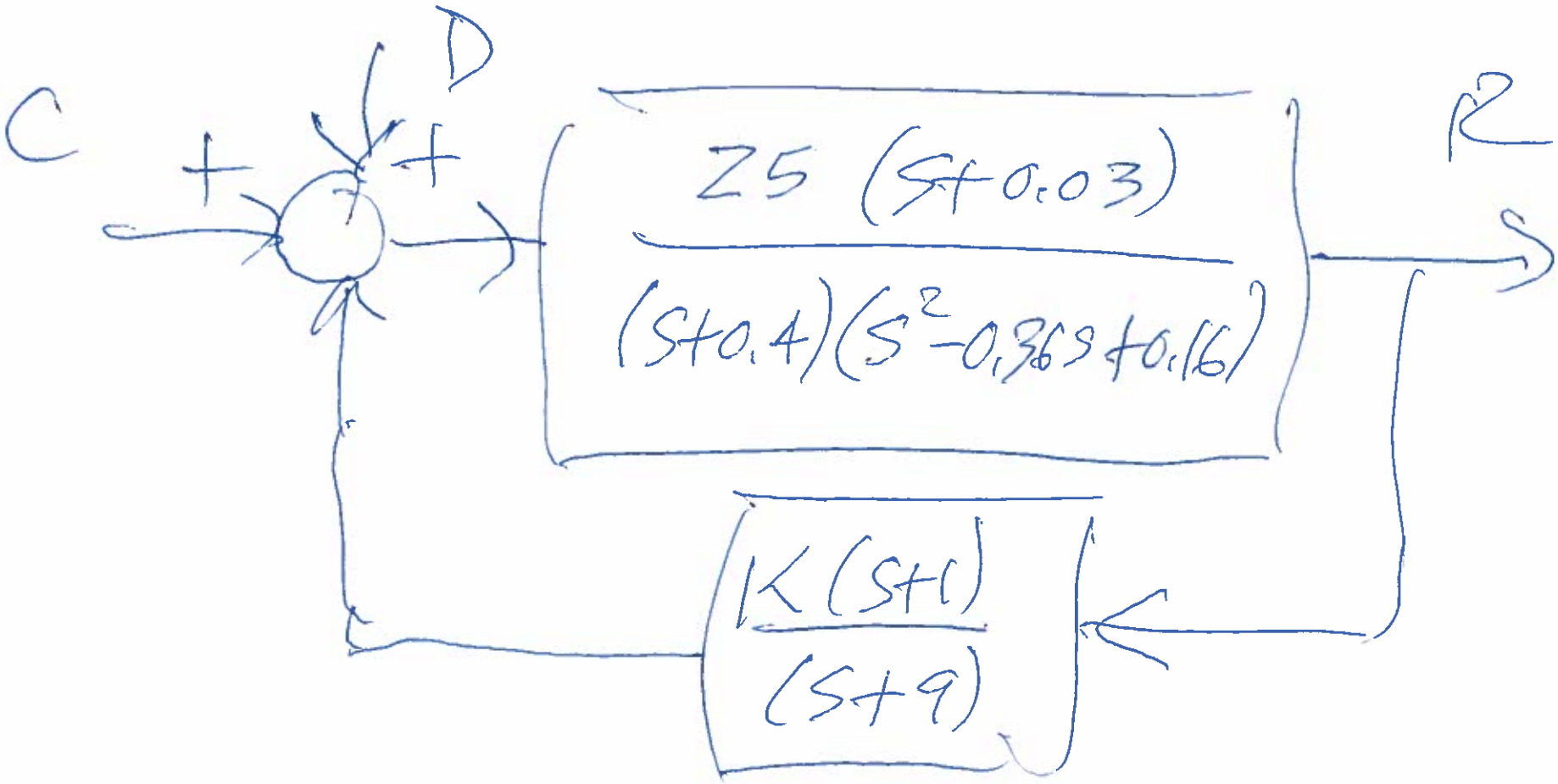
$N_p = 0$

UNSTABLE ZEROS

$N_Z = N + N_p = 2 + 0 = 2$

UNSTABLE

HELICOPTER CONTROL



GH FUNCTION

$$GH = \frac{25K(s+0.03)(s+1)}{(s+9)(s+0.4)(s^2-0.36s+0.16)}$$

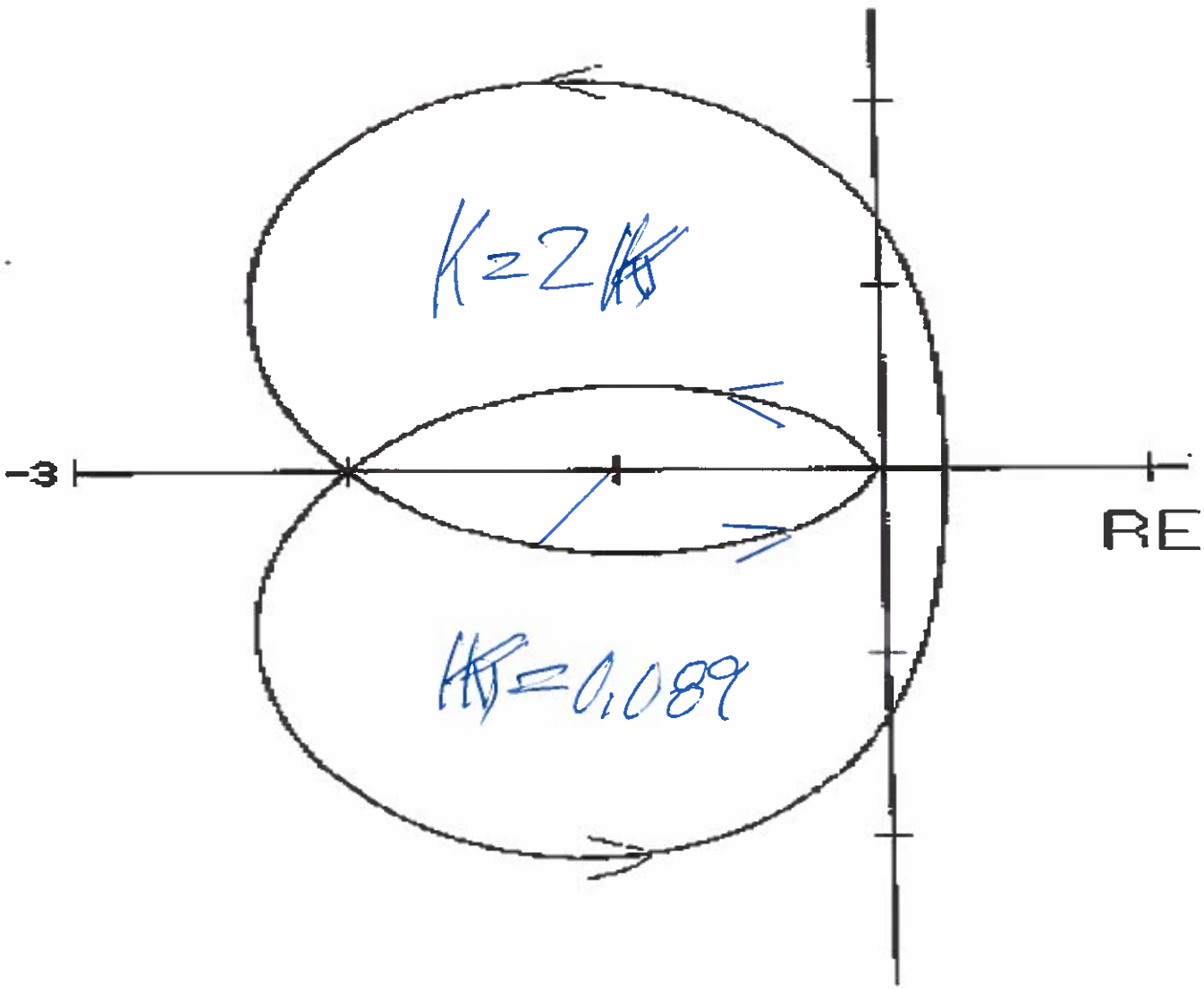
GH POLES

$S = -9 \qquad S = -0.4$

$S = +0.18 + 0.36j$

$S = +0.18 - 0.36j$

UNSTABLE POLES $N_p = 2$


K=2
-3
RE
K=0,089

INTERPRETATION

NET CLOCKWISE ROTATIONS

$N = -(-(= -2$

UNSTABLE POLES

$N_p = 2$

UNSTABLE ZEROS

$N_z = N + N_p = -2 + 2 = 0$

STABLE

```
%
% gh plots
%
clear all
w=0.4; dw=0.1;
nit=100; lag=0.0;
for it=1:nit
s=complex(0.0,w);
delay=exp(-lag*s);
% helicopter  control
map=25.0*2.0*0.089*(s+0.03) ...
    *(s+1.0)/(s+9.0)/(s+0.4) ...
       /(s*s-0.36*s+0.16);
% speech control
map=0.1*2.0*20004.0*100000.0/ ...
    (0.1*s+1.0)/(s*s+200*s ...
          +10000000.0);
% submarine control
map=2.0*0.455*(s+1.0)*(s+1.0) ...
         /s/(s*s+0.09);
p(it)=real(map);
g(it)=imag(map);
w=w+dw;
end;
plot(p,+q,p,-q)
title('nyquist plot')
xlabel('real')
ylabel('imag')
grid
```