Control Systems

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***Abstract*—This manual is an introduction to control systems based on GATE problems.Links to sample Python codes are available in the text.**

Download python codes using

```
svn co https://github.com/gadepall/school/trunk/
    control/codes
```

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6.1. Using the Nyquist criterian , find out whether the system is stable or not

$$G(s) = \frac{20}{s(s+1)} \tag{6.1.1}$$

$$H(s) = \frac{s+3}{s+4} \tag{6.1.2}$$

6.2. **Solution:**

$$G(s)H(s) = \frac{20(s+3)}{s(s+1)(s+4)} \tag{6.2.1}$$

$$= \frac{20s+60}{s^3+5s^2+4s}$$

$$1+G(s)H(s) = \frac{s^3+5s^2+24s+60}{s^3+5s^2+4s} \tag{6.2.2}$$

6.3. Nyquist Stability Criterion can be expressed as:

$$Z = N + P \tag{6.3.1}$$

Where:

Z = number of roots of 1+G(s)H(s) in right-hand side (RHS) of s-plane (It is also called zeros of characteristics equation)

N = number of encirclement of critical point 1+j0 in the clockwise direction

P = number of poles of open loop transfer function (OLTF) [i.e. G(s)H(s)] in RHS of s-plane.

Z=N+P is valid for all the systems whether stable or unstable. For the stable system, Z=0, So for the stable system N = –P.

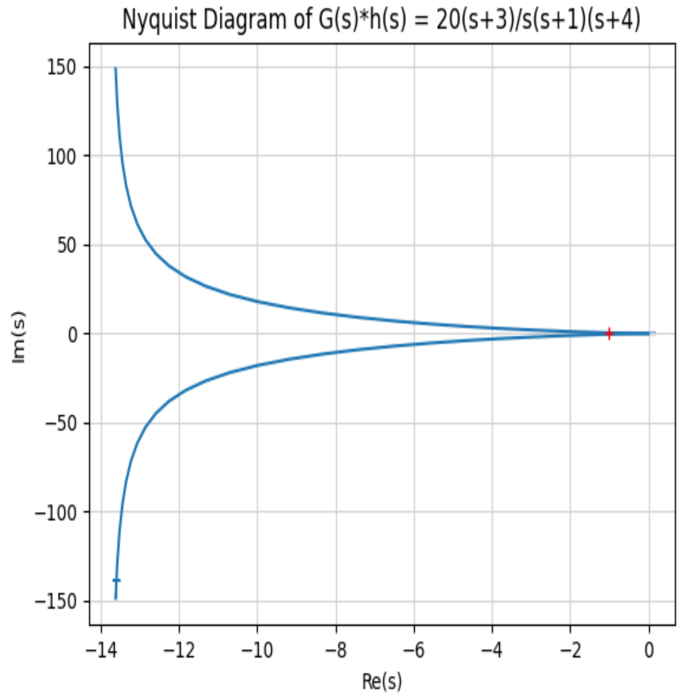
if p = 0

there will be no Encirclement of Nyquist plot and the system is stable

$$G(s)H(s) = \frac{20(s+3)}{s(s+1)(s+4)} \tag{6.3.2}$$

$$Here\ P = 0 \tag{6.3.3}$$

$$Then\ N = 0 \tag{6.3.4}$$



by seeing the we conclude that N = 0 and P = 0

$$hence\ the\ systen\ is\ stable \tag{6.3.5}$$

verify the answer with python code https://github.com/srikanth2001/EE2227-control-systems/tree/master/codes

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