Contents

***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
```

1 Stability

2 Routh Hurwitz Criterion

3 Compensators

4 Nyquist Plot

4.1 Polar plot

4.1. Sketch the Polar Plot for

$$G(s) = \frac{1}{(1+s)(1+2s)} \tag{4.1.1}$$

Solution: Then the given open loop Transfer Function is

$$G(s) = \frac{1}{(1+s)(1+2s)} \tag{4.1.2}$$

Now we have substitute s=jω

$$G(j\omega) = \frac{1}{(1+j\omega)(1+2j\omega)} \tag{4.1.3}$$

4.2. Then find the Magnitude of the Transfer Function
Solution:

$$|G(j\omega)| = \frac{1}{\sqrt{(1+(\omega^2))(1+(2\omega)^2}} \tag{4.2.1}$$

4.3. Next find the Phase of Transfer Function
Solution:

$$\angle G(j\omega) = \angle G(j\omega)_{num} - \angle G(j\omega)_{den} \tag{4.3.1}$$

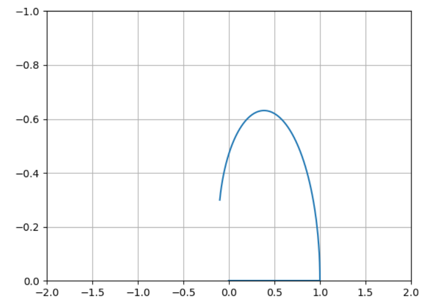

Fig. 4.4: Different systems based on ζ

$$\angle G(j\omega) = -tan^{-1}(\omega) - tan^{-1}(2\omega) \tag{4.3.2}$$

4.4. Polar plot is drawn based on this magnitude and phase of transfer function
Solution:
For ω=0

$$|G(j\omega)| = 1 \tag{4.4.1}$$
$$\angle G(j\omega) = 0 \tag{4.4.2}$$

For w= ∞

$$|G(j\omega)| = 0 \tag{4.4.3}$$
$$\angle G(j\omega) = -\pi \tag{4.4.4}$$

Next Polar Plot is drawn by varying ω from 0 to ∞.

4.5. Verify the Polar Plot by running the following Code

```
codes/ Ketan_A1(a).pyc
```