SNS COLLEGE OF TECHNOLOGY

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Department of Biomedical Engineering

Course Name: Biocontrol System

II Year : IV Semester

Unit III –Frequency Response Analysis

Topic : Nyquist Stability Criterion

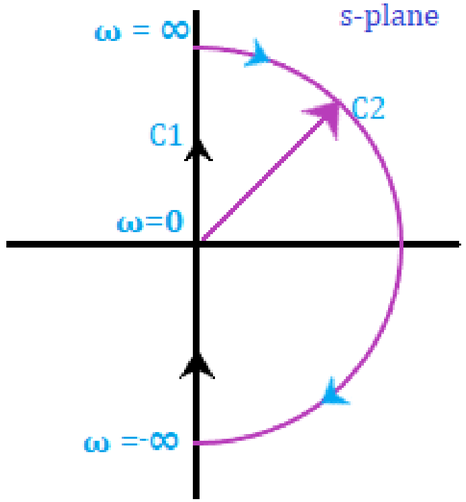
Nyquist Stability-Procedure

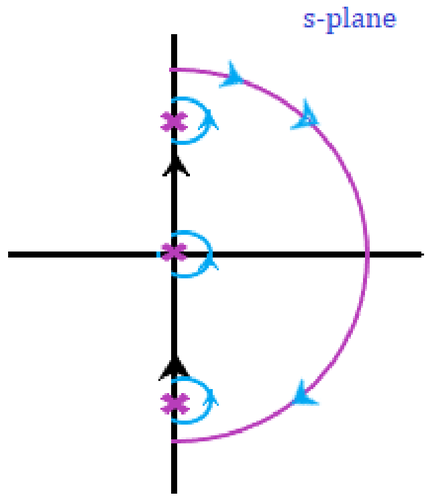
Determining the poles and zeroes

From the given transfer function, we need to determine the poles and zeroes to check the valid points.

2. **Selecting a Nyquist plot**

We need to select a Nyquist plot that should enclose all the poles and zeroes present on the right-half of the s-plane except the singular points.

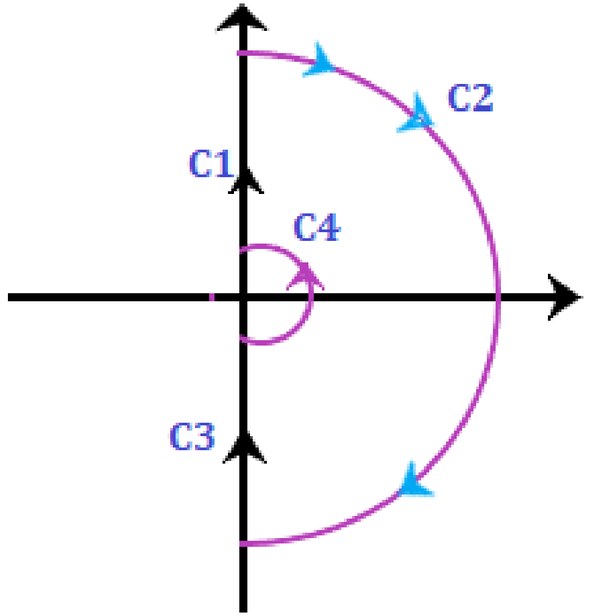




Nyquist Stability

3. Mapping a contour

The Nyquist contour is mapped to determine the encirclement of the point -1 + j0. The contour is drawn based on the transfer function is G(s)H(s). There are four sections C1, C2, C3, and C4.



Nyquist Stability

4. **Range for the first section C1:**

   We know that the Nyquist range is from -infinity to infinity, and the value of ω in section C1 ranges from 0 to infinity. The contour will be drawn in G(s)H(s) plane with respect to the above range, and it will be the locus plot of G(jω)H(jω).

5. **Range for the second section C2:**

   The second section is generally of infinite radius. Here, it is a semi-circle of infinite radius. The range of the second section is from -90 degrees to +90 degrees.

$$\lim_{R\to\infty} Re^{j\theta}$$

$$\theta = -\frac{\pi}{2} \text{ to } +\frac{\pi}{2}$$

Nyquist Stability

6. **Range for the second section C3:**

   In the third section C3, the value of ω ranges from -infinity to zero. The locus of the third section is just the inverse of the polar plot of G(jω)H(jω). The resulted plot will be the mirror image of the polar with respect to the real axis.

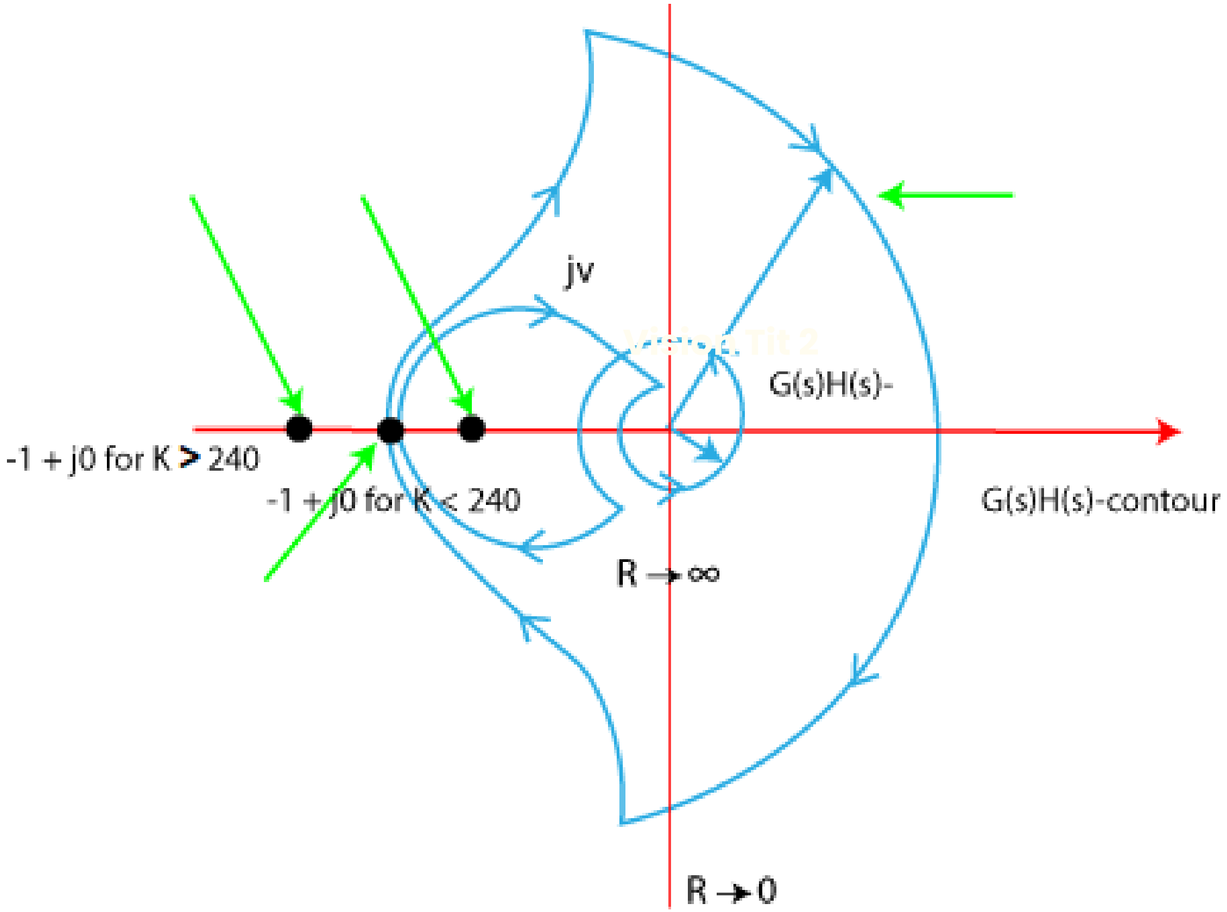
7. **Range for the second section C4:**

   The argument of the forth section varies from-90 degrees to 90 degrees. The Nyquist contour of this section has a semicircle of zero radii.

$$\lim_{R \to 0} Re^{-j\theta}$$

$$\theta = -\frac{\pi}{2} \text{ to } +\frac{\pi}{2}$$

Nyquist Stability



Nyquist plot of $G(s)\,H(s) = \dfrac{K}{s(s+2)(s+10)}$