SNS COLLEGE OF TECHNOLOGY

Coimbatore-15
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT212 – CONTROL SYSTEMS

II YEAR/ IV SEMESTER

UNIT IV – STABILITY ANALYSIS

TOPIC 4.5,6 ROOT LOCUS STABILITY,DOMINANT POLES

OUTLINE

- REVIEW ABOUT PREVIOUS CLASS
- ROOT LOCUS EXAMPLE PROBLEM
- ROOT LOCUS STABILITY EXAMPLE
- ACTIVITY
- DOMINANT POLES- MEANING & CONCEPTS
- DOMINANT POLES-GATE 2007 PROBLEM
- SUMMARY

ROOT LOCUS-EXAMPLE

Let us now draw the root locus of the control system having open loop transfer function, $G(s)H(s)=K / s(s+1)(s+5)$

Step 1 – The given open loop transfer function has three poles at

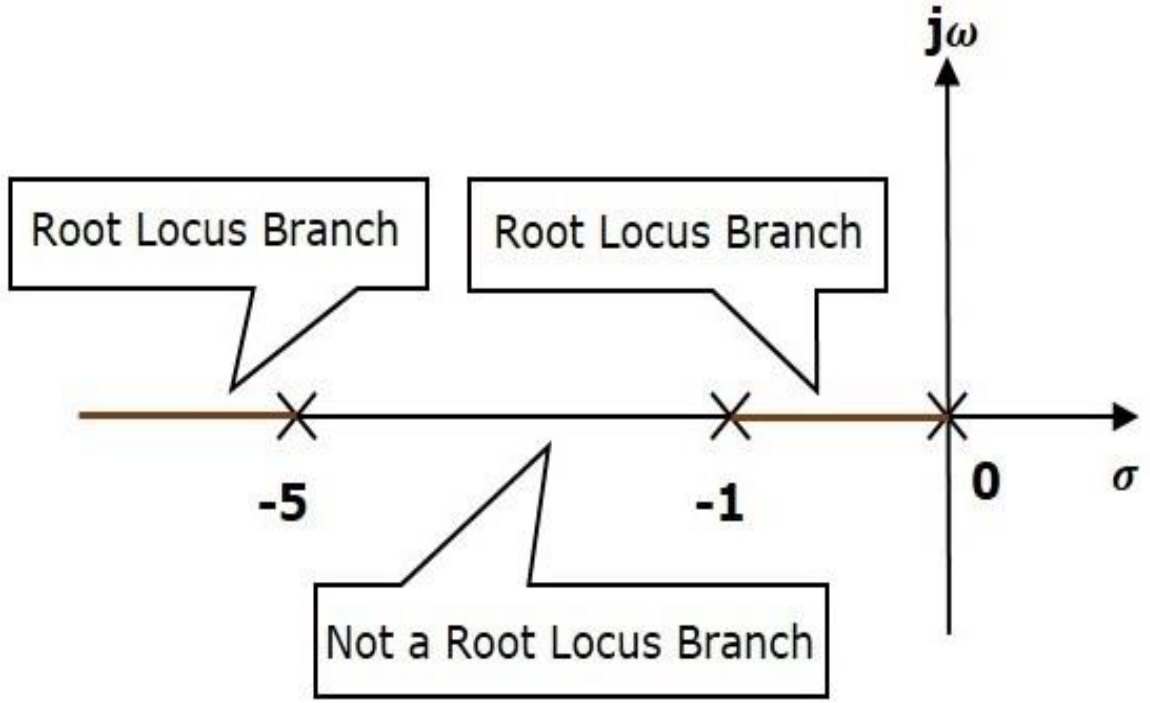
s=0,s=−1s=0,s=−1 and s=−5s=−5.

It doesn't have any zero.

Therefore, the number of root locus branches is equal to the number of poles of the open loop transfer function.

N=P=3

ROOT LOCUS-EXAMPLE



The three poles are located are shown in the above figure. The line segment between s=−1s=−1 and s=0s=0 is one branch of root locus on real axis.

And the other branch of the root locus on the real axis is the line segment to the left of s=−5 s=−5.

ROOT LOCUS-EXAMPLE

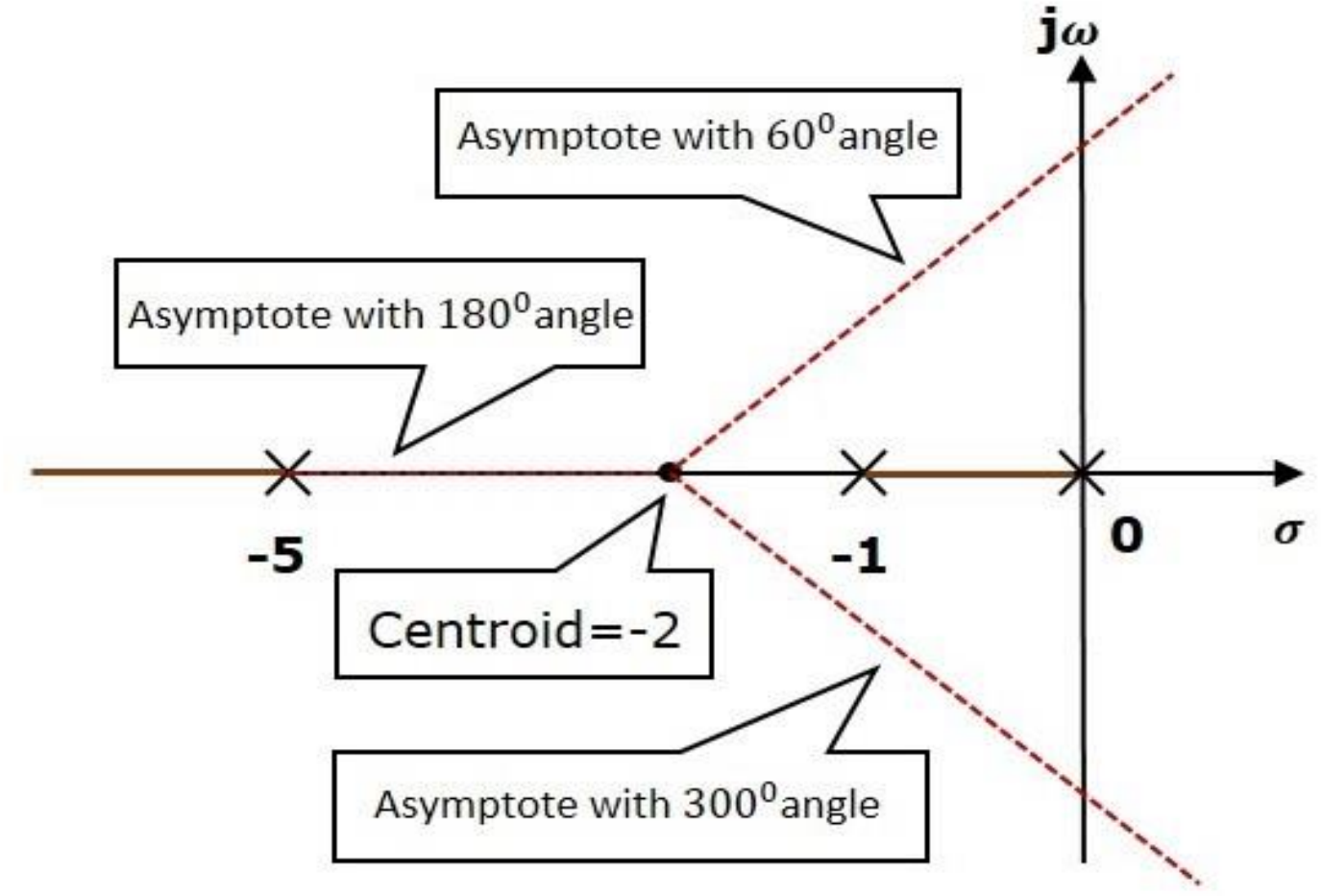
Step 2 – We will get the values of the centroid and the angle of asymptotes by using the given formulae.

Centroid $\alpha=-2\alpha=-2$

The angle of asymptotes are $\theta=60$,180 and 300 degrees

The centroid and three asymptotes are shown in the following figure.

ROOT LOCUS-EXAMPLE



ROOT LOCUS-EXAMPLE

Step 3 – Since two asymptotes have the angles of 60 and 300, two root locus branches intersect the imaginary axis.

By using the Routh array method and special case(ii), the root locus branches intersects the imaginary axis at $j5-\sqrt{j5}$ and $-j5-\sqrt{-j5}$.

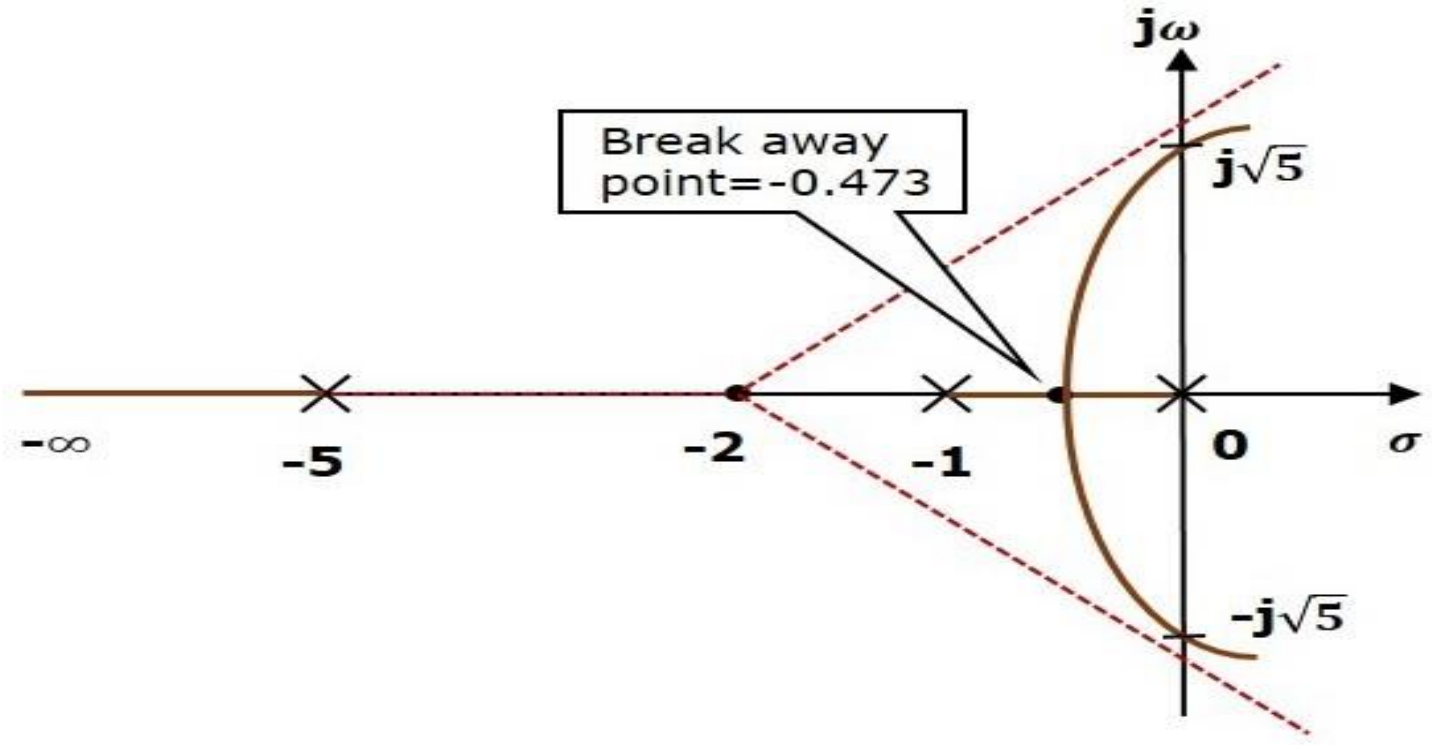
There will be one break-away point on the real axis root locus branch between the poles $s=-1$ and $s=0$.

By following the procedure given for the calculation of break-away point, we will get it as $s=-0.473$.

The root locus diagram for the given control system is shown in the following figure.

In this way, you can draw the root locus diagram of any control system and observe the movement of poles of the closed loop transfer function.
From the root locus diagrams, we can know the range of K values for different types of damping.

ROOT LOCUS-EXAMPLE



Root Locus : Stability

- https://www.youtube.com/watch?v=mXLoSkuzKpY

ACTIVITY

What occurs twice in a week, once in a year, but never in a day?

FIND MISSING NO.

1. 201,202,204,207,---
2. 8,12,9,13,10,14,11,--,--

DOMINANT POLES

The **poles** near to the jw axis are called the **dominant poles**. Or, get the closed-loop TF from Open loop TF.

Determine the **poles** of the denominators.

The **poles** which have very small real parts or near to the jw axis have small damping ratio. These **poles** are the **dominant poles** of the system.

The Concept of Dominant Pole
https://www.youtube.com/watch?v=_s1Z33VXjbU

Dominant Poles Gate 2007 Problem : https://www.youtube.com/watch?v=a3KUBu8NEr0

SUMMARY