1

In control theory and stability theory, root locus analysis is a graphical method for examining how the roots of a system change with variation of a certain system parameter, commonly a gain within a feedback system. This is a technique used as a stability criterion in the field of classical control theory developed by Walter R. Evans which can determine stability of the system. The root locus plots the poles of the closed loop transfer function in the complex s-plane as a function of a gain parameter.

2

When all the Elements of any row of the Routh array are zero

In this case we follow these two steps −

* Write the auxilary equation, A(s) of the row, which is just above the row of zeros.
* Differentiate the auxiliary equation, A(s) with respect to s. Fill the row of zeros with these coefficients.

**Example**

Let us find the stability of the control system having characteristic equation,

s5+3s4+s3+3s2+s+3=0

**Step 1** − Verify the necessary condition for the Routh-Hurwitz stability.

All the coefficients of the given characteristic polynomial are positive. So, the control system satisfied the necessary condition.

**Step 2** − Form the Routh array for the given characteristic polynomial.

|  |  |  |  |
| --- | --- | --- | --- |
| s5 | 1 | 1 | 1 |
| s4 | ~~3~~ 1 | ~~3~~ 1 | ~~3~~ 1 |
| s3 | (1×1)−(1×1)1=0(1×1)−(1×1)1=0 | (1×1)−(1×1)1=0(1×1)−(1×1)1=0 |  |
| s2 |  |  |  |
| s1 |  |  |  |
| ss0 |  |  |  |

The row s4s4 elements have the common factor of 3. So, all these elements are divided by 3.

**Special case (ii)** − All the elements of row s3s3 are zero. So, write the auxiliary equation, A(s) of the row s4s4.

A(s)=s4+s2+1

Differentiate the above equation with respect to s.

dA(s)ds=4s3+2s

Place these coefficients in rows3.

Question 2b

When the poles of a closed loop system are on the imaginary axis jw they form conjugate pairs and because the poles are on the imaginary axis and not on the right half plane the system can be described as a marginally stable system. The stable stability can be further derived by using the method in the preceding question.