Routh's stability criterion to linear feedback systems:

Routh's Stability Criterion: Routh's stability criterion is a method used to determine the stability of a linear system based on the coefficients of its characteristic equation. It provides a necessary and sufficient condition for stability.

Characteristic Equation: The characteristic equation of a linear feedback system is obtained by setting the denominator of its transfer function to zero. It is typically represented as a polynomial equation in the Laplace variable 's'.

Coefficient Calculation: To apply Routh's stability criterion, the coefficients of the characteristic equation are arranged in a tabular form known as the Routh array. The Routh array is constructed by grouping the coefficients of the polynomial in descending powers of 's'.

Routh Array Construction: The Routh array consists of rows that alternate between two rows. The first row contains the coefficients of the even powers of 's' (starting from the highest power), and the second row contains the coefficients of the odd powers of 's'. These rows are used to calculate the subsequent rows of the Routh array.

Rule of Routh Array Construction: To construct the Routh array, you follow these steps:

a. Write the coefficients of the even powers of 's' in the first row.

b. Write the coefficients of the odd powers of 's' in the second row.

c. Calculate the elements of subsequent rows by using the following formula:

Element in row i and column j = (Element in row (i-1), column 1) * (Element in row (i-2), column (j+1)) - (Element in row (i-2), column 1) * (Element in row (i-1), column (j+1))

d. Repeat step c for each element in the row until the entire Routh array is constructed.

Stability Analysis: After constructing the Routh array, the stability of the linear feedback system can be determined based on the following conditions:

a. All the elements in the first column of the Routh array are positive.

b. If any element in the first column is zero or changes sign, it indicates the presence of poles in the right-half plane, which implies instability.

Stability Conclusion: Based on the results obtained from the Routh array, you can conclude the stability of the linear feedback system:

a. If all the elements in the first column are positive, the system is stable.

b. If any element in the first column is zero or changes sign, the system is unstable.

c. If all the elements in a row are zero, the system may be marginally stable, and further analysis is required.