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EEE 441 (Servomechanism) Assignment.

Q1. Briefly explain the Root Locus Technique:

Answer

The Root Locus technique in control system, is a technique used to evaluate the position of the roots, their locus of movement and ~~the~~ other associated information, and these information will be used to comment upon the system performances.

This technique is also a graphical representation in s-domain and it is symmetrical about the real axis (σ). This is because the open loop poles and zeros exist in the s-domain, having the values either as real or as complex conjugate pairs.

Root locus problems are solved using procedures known as; "Rule for construction of Root Locus plot".

Q2a) Describe the use of Routh Hurwitz to find stability of a closed loop system when an entire row is zero on the Routh table.

Answer

The polynomial whose coefficients are the elements of the row just above the row of zeros in the routh Hurwitz array is called the "auxillary polynomial", and the order of the auxillary polynomial is always even.

Using an example to explain this further

$s^6+s^5+5s^4+3s^3+2s^2-4s-8=0$

Solution

s^6	1	5	2	-8	
s^5	1	3	-4	0	
s^4	2	6	-8	0	→ Auxillary polynomial
s^3	0	0	0	0	
s^2					
s^1					
s^0					

On the s^3 array of the Routh table, all the rows will be equivalent to zero

* Therefore, the elements of the S^4 row, which is the row just above the rows whose elements are zero, will become the "auxiliary polynomial".

* Auxiliary polynomial $= 2s^4 + 6s^2 + 8 = 0$
* Now, we would differentiate the auxiliary polynomial w.r.t S

$$\therefore \frac{d}{ds}[2s^4 + 6s^2 - 8] \Rightarrow 8s^3 + 12s = 0$$

* Now, we would continue the Routh table by inserting the derivate of the auxiliary polynomial into the S^3 array.

s^6	1	5	2	-8
s^5	1	3	-4	0
s^4	2	6	-8	0
s^3	8	12	0	0
s^2	3	-8	0	0
s^1	33.33	0	0	0
s^0	-8	0	0	0

Comment: From the hurwitz array, we can see that there was one sign change from $s' \rightarrow s^0$ therefore, we can say that ~~three~~ pole was shifted to the right-half of the s-plane.

Therefor, the system is **unstable**

Q5) Describe the use of Routh hurwitz array to find the stability of a closed loop system ~~and~~ determine the poles on the imaginary ($j\omega$) axis.

Answer: If all the ~~poles~~ of the roots of the system, lie on the imaginary axis of the s-plane, then the system is said to be marginally stable.