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MECHATRONIC ENGINEERING
17/ENG05/013
EEE 441

Question 1: Root Locus is a graphical presentation of the closed loop poles as a system parameter is varied. The root locus also gives a graphical presentation of a system's stability. Before presenting root locus.

The Root Locus technique can be used to analyze & design the effect of a loop gain upon systemic transient response & stability.
The closed loop transfer function for system with a gain K is

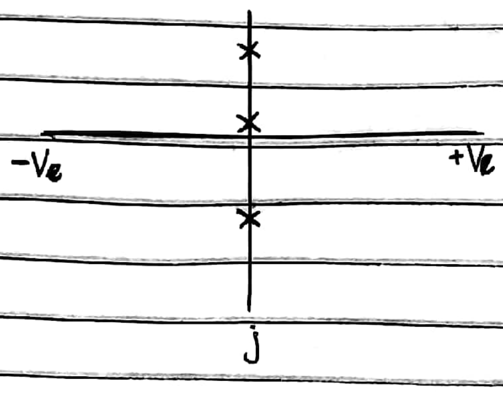
$$T(s) = \frac{KG(s)}{1 + KG(s)H(s)}$$

From this equation, a pole exists when the characteristic polynomial in the denominator becomes zero or

$$KG(s)H(s) = -1 = 1\angle(2K+1)180^\circ \quad \text{where } K = 0, \pm1, \pm2, \pm3, \pm4 \text{ -----}$$

When -1 represented in polar form as $1\angle(2K+1)180^\circ$, Alternatively a value of s is a closed loop pole if $|KG(s)H(s)| = 1$ and $\angle KG(s)H(s) = (2K+1)180^\circ$

Question 2: The use of Routh Hurwitz to find stability of a closed loop system when Entire row is zero on the Routh Hurwitz table to determine poles of the $j\omega$ axis



This is the indication of roots on the imagmery axis.
This means or makes the system limitedly stable or marginally stable.

With the use of an Example:

Consider the characteristics Equation below

$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$

s^6	1	8	20	16
s^5	$2/2 = 1$	$12/2 = 6$	$16/2 = 8$	
s^4	$2/2 = 1$	$12/2 = 6$	$16/2 = 8$	
s^3	0	0	0	

Therefore

Application of Auxillary Equation

$s^4 =$ even 1

Therefore $= s^4 + 6s^2 + 8s^0 = 0$

To get s^3

$\frac{dA}{ds} = \frac{d}{ds}\left[s^4 + 6s^2 + 8\right]$

$s^3 = 4s^3 + 12s^1 + 0$

$s^3 = 4s^3 + 12s$

S^6	1	8	20	16
S^5	1	6	8	
S^4	1	6	8	
S^3	$4/4 = 1$	$12/4 = 3$		
S^2	3	8		
S^1	0.33	0		
S^0	8			

No sign changes which means no positive poles

Due to the Entire row of zeros means there are roots lying on the $j\omega$ axis.

This means that the system is marginally stable or has limited stability.