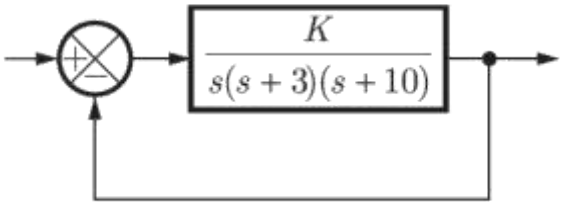
Type-3: Routh Stability Criterion

For Concept, refer to Control Systems K-Notes Control System Stability

Common Mistake:
A row of zeroes does not guarantee the existence of poles on jw axis, we must first calculate the roots of auxiliary polynomial and then decide.

Sample Problem 3:
Figure shows a feedback system where K > 0, the range of K for which the system is stable will be given by



(A) 0 < K < 30
(B) 0 < K < 39
(C) 0 < K < 390
(D) K > 390

Solution: (C) is correct option .

Characteristic equation for the system

$$1+\frac{K}{s(s+3)(s+10)}=0$$

$$s(s+3)(s+10)+K=0$$

$$s^3+13s^2+30s+K=0$$

S^3	1	30
S^2	13	K
S^1	$\frac{(13\times30)-K}{13}$	
S^0	K	

Applying Routh's stability criteria.
For stability there should be no sign change in first column
So, $390 - K > 0$ & $K < 390$
$\because K > 0$, $\therefore 0 < K < 390$

Unsolved Problems:

Q.1 The open loop transfer function of a system is $G(s)H(s)=\frac{K(s+4)}{s(s^2+2s+2)}$, the root locus will intersect the imaginary axis at

(A) $\pm j2$ (B) $\pm j\sqrt{2}$ (C) $\pm j\sqrt{10}$ (D) $\pm j\sqrt{102}$

Q.2 The Routh – Hurwitz array is given for a third order characteristic equation as follows

S^3	a	b	0
S^2	c	d	0
S^1	$\frac{10-k}{2}$	0	
S^0	k		

The values of a, b, c, d are respectively, for which the system should be marginally stable

(A) 1 5 2 10 (B) 2 10 1 5

(C) 10 1 2 5 (D) 1 2 5 10

Q.3 The open loop transfer function of a control system is given by $\frac{K(s+10)}{s(s+2)(s+\alpha)}$ .The smallest possible value of "α" for which this system is stable in the closed-loop for all positive values of k is

(A) 0 (B) 8 (C) 10 (D) 12

Q.4 The no of right hand, left hand, and jω axis poles are respectively $T(s)=\frac{s^2+7s+10}{s^6+2s^4-s^2-2}$

(A)3,1,2 (B)2,1,2 (C)4,0,2 (D) 1,1,4

Q.5 Consider the characteristic equation $D(s) = s^5 + S^4 + 3s^3 + 3s^2 + 6s + 4$ .Then system is stable or unstable and if unstable, then how many poles lie in the right half of s-plane.

(A) Unstable, 3 poles lie in the right half of s plane

(B) Stable, 0 poles lie in the right half of s plane

(C) Unstable, 2 poles lie in the right half of s plane

(D) None of these