ECE317
Routh Hurwitz Problems

❑ DRILL PROBLEMS

D2.9 What can be determined about the roots of the following polynomials from the coefficient tests?

(a)

$-3s^4 + 2s^3 + s + 10$

Ans. at least one RHP root

(b)

$4s^4 + 3s^3 + 10s^2 + 8s + 1$

Ans. nothing

(c)

$s^5 + 4s^3 + 8$

Ans. imaginary axis (IA) or RHP roots or both

(d)

$s^6 + 6s^4 + 3s^2 + 10$

Ans. IA or RHP roots or both

D2.10 How many roots of each of the following polynomials are in the right half of the complex plane?

(a)

$s^3 + 2s^2 + 3s + 4$

Ans. 0

(b)

$s^4 - 6s^3 + 7s^2 + 2s + 4$

Ans. 2

(c)

$0.3s^4 + 1.1s^3 + 0.7s^2 + s + 2.1$

Ans. 2

(d)

$s^5 + s^4 + 2s^3 + 3s^2 + \frac{1}{2}$

Ans. 4

(e)

$2s^5 + s^4 + 2s^3 + 4s^2 + s + 6$

Ans. 2

D2.11 The Routh–Hurwitz tests for the following polynomials might involve left-column zeros. For each polynomial, use the array to find the number of roots in the right half of the complex plane.

(a)

$s^3 + 2s + 3$

Ans. 2

(b)

$3s^4 + 6s^3 + 2s^2 + 4s + 5$

Ans. 2

(c)

$2s^4 + 2s^3 + s^2 + s - 3$

Ans. 1

(d)

$s^5 + s^4 + 3s^3 + 2s^2 + 4s + 2$

Ans. 2

D2.12 The Routh–Hurwitz tests for the following polynomials might involve an all-zero row in the arrays. For each polynomial, complete the array and determine the number of roots in the right half of the complex plane.

(a)

$s^4 + 8s^2 - 7$

Ans. 1

(b)

$s^4 + 2s^3 + 9s^2 + 4s + 14$

Ans. 0

(c)

$s^5 + s^3 + 2s$

Ans. 2

(d)

$s^5 + 3s^4 + 4s^3 + 7s^2 + 4s + 2$

Ans. 0

D2.13 For each of the following polynomials, how many roots are in the LHP, how many are in the RHP, and how many are on the imaginary axis?

(a)

$$s^4 + 3s^2 + 4$$

Ans. 2 RHP, 2 LHP

(b)

$$s^4 + 2s^3 + 5s^2 - 4s - 14$$

Ans. 1 RHP, 3 LHP

(c)

$$s^5 + 2s^4 + 3s^3 + 6s^2 + 2s + 4$$

Ans. 1 LHP, 4 IA

(d)

$$3s^5 + 2s^3 + s$$

Ans. 2 RHP, 2 LHP, 1 IA

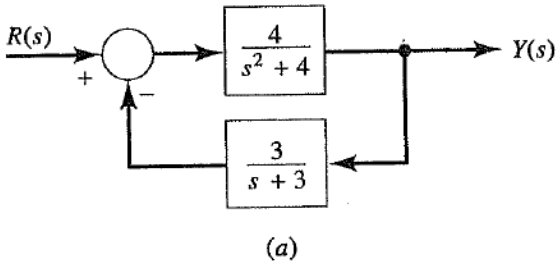
(e)

$$2s^5 + 4s^4 + s^3 + 2s^2 + 3s + 6$$

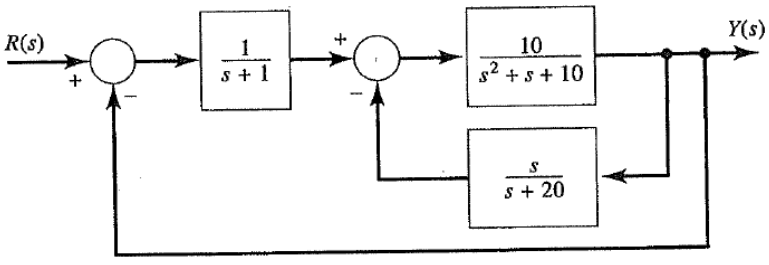
Ans. 3 LHP, 2 RHP

D2.14 Are the systems of Figure D2.14 stable?

Ans. (a) no; (b) yes



(a)



(b)

Figure D2.14