Discussion Problems

Week 4

Problems: 3.53c, 3.54b, 3.56

3.53 Suppose that unity feedback is to be applied around the listed open-loop systems. Use Routh's stability criterion to determine whether the resulting closed-loop systems will be stable.

(a) $KG(s) = \frac{4(s+2)}{s(s^3+2s^2+3s+4)}$

(b) $KG(s) = \frac{2(s+4)}{s^2(s+1)}$

(c) $KG(s) = \frac{4(s^3+2s^2+s+1)}{s^2(s^3+2s^2-s-1)}$

3.54 Use Routh's stability criterion to determine how many roots with positive real parts the following equations have:

(a) $s^4 + 8s^3 + 32s^2 + 80s + 100 = 0$

(b) $s^5 + 10s^4 + 30s^3 + 80s^2 + 344s + 480 = 0$

(c) $s^4 + 2s^3 + 7s^2 - 2s + 8 = 0$

(d) $s^3 + s^2 + 20s + 78 = 0$

(e) $s^4 + 6s^2 + 25 = 0$

3.56 The transfer function of a typical tape-drive system is given by

$$KG(s) = \frac{K(s+4)}{s[(s+0.5)(s+1)(s^2+0.4s+4)]},$$

where time is measured in milliseconds. Using Routh's stability criterion, determine the range of K for which this system is stable when the characteristic equation is $1 + KG(s) = 0$.