Eskişehir Osmangazi University - Electrical Engineering Department Fundamentals of Control Systems Second Midterm Examination - Spring 2009

1. [25 pts.; no partial credits] Consider the configuration in Fig. 1. Let $G(s) = \frac{1}{(s+1)(s-1)(s+i)(s-i)}$. Which of the following is/are on the root locus? 0.5, -0.5, 0.5i, -0.5i, 1.5, -1.5, 1.5i, -1.5i



Figure 1: Configuration referenced by Problems 1 and 2

2. [20 pts.] Consider the configuration in Fig. 1. Let $G(s) = \frac{1}{(s+2)(s+3)}$. Plot the closed loop system's poles as K varies from 0 to ∞ . [5 pts.] Is the closed loop system stable for K = 5.

3. [15 pts.] Obtain the Routh table for the polynomial equation $2s^4 + 3s^3 + s^2 + 2s + 5 = 0$. [10 pts.] How many roots are on the open left half plane?

4. [25 pts.; no partial credits] Which of the following transfer functions is/are BIBO stable?

a) $\frac{-1}{(s+2)(s^2+9)}$, b) $\frac{2}{(s+2)(s-3)}$ c) $\frac{1}{(s+i)(s-i)}$, d) $\frac{1}{s+1}$, e) $\frac{s-2}{(s+1)(s+3)}$ Good Luck,

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Solutions

1. 0.5, -0.5, 0.5i, -0.5i are on the root locus.



Figure 2: Root locus for Problem 1

2.



Figure 3: Root locus for Problem 2

3.

Ε	2,	1,	5]
[З,	2,	0]
[-1/3,	5,	0]
[47,	0,	0]
[5,	0,	0]

Two roots are on the left half complex plane. **4.** d) $\frac{1}{s+1}$, e) $\frac{s-2}{(s+1)(s+3)}$