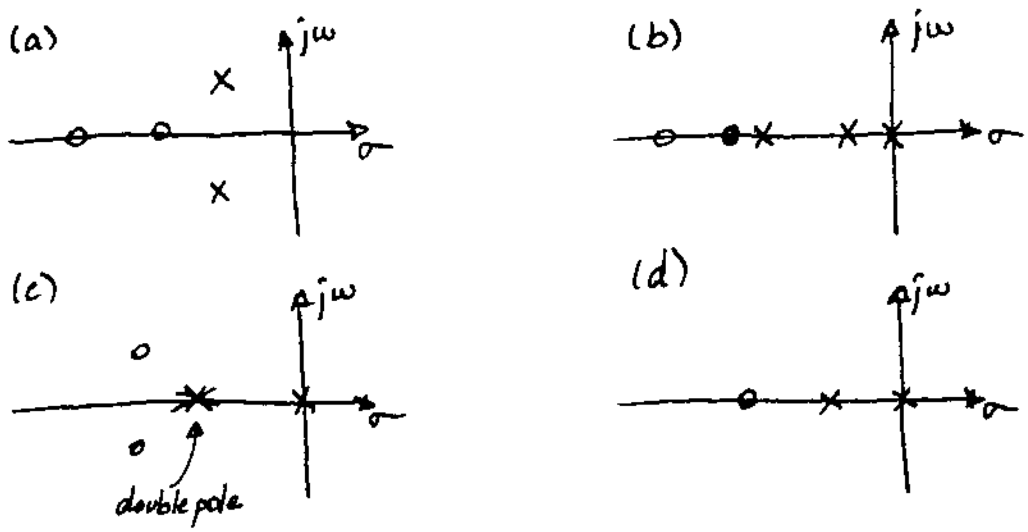
EE 231 | **Exam#3** | **May 02, 1991**

75 minutes

1. For the following open-loop pole/zero locations, sketch *expected* root-locus diagrams. *Do not* determine any features of the diagram, simply show the expected shapes of all the root-locus branches. (20pts)



2. Consider a unity-feedback control system with the open-loop transfer function

should have been "+"

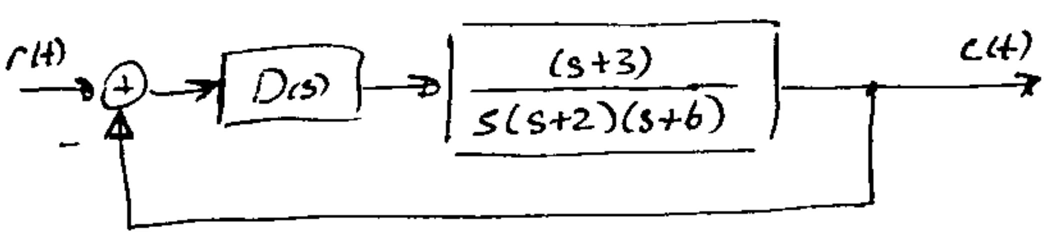
$$G(s) = K\frac{s^2 - 2s + 2}{(s-1)^2(s+4)(s+6)}$$

   (a) Construct the root-locus diagram. Determine the important features like asymptotes, imaginary-axis crossings, angle of arrivals or departures; however *do not* determine the break-away and/or break-in points explicitly. Obtain only the equation whose solutions would give those points i.e., *do not solve that equation.* (40pts)

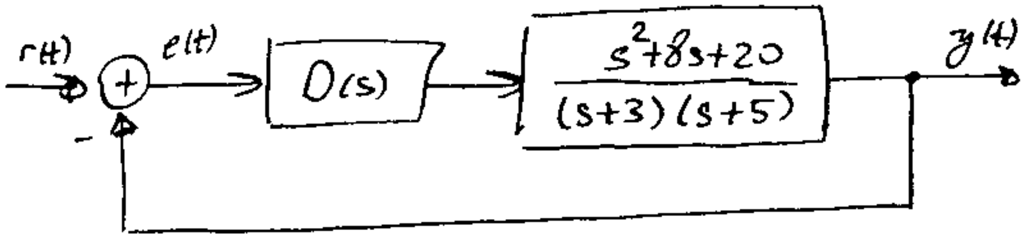
   (b) Determine all the values of K such that the closed-loop system is stable. (05pts)

   (c) Determine all the value(s) of K such that the system has sustained oscillations. (05pts)

3. For the following system, design a first-order compensator $D(s)$, such that the closed-loop complex poles are at $s = -3 \pm j\,3$, and the steady-state error is (almost) minimum. (20pts)



4. For the following system, design a stable compensator $D(s)$, such that the steady state error $e(\infty)$ for the *unit-ramp* input is less than 0.2. Here, assume that the largest finite compensator time-constant allowable is 50. (10pts)



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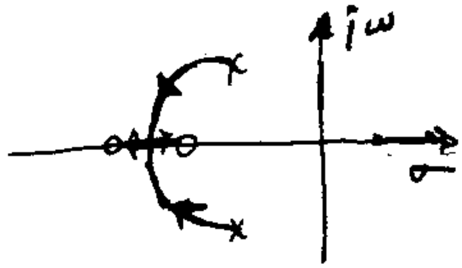
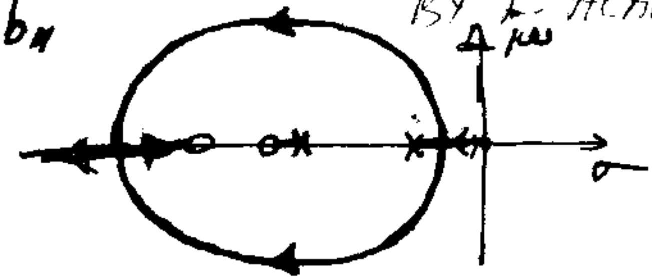
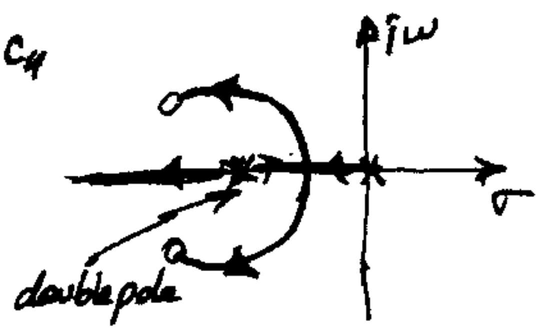
#1 a)



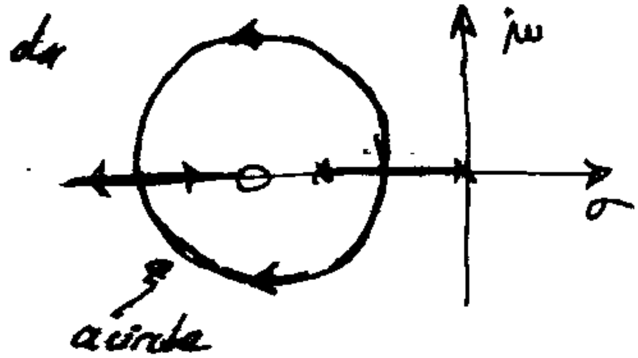
b)



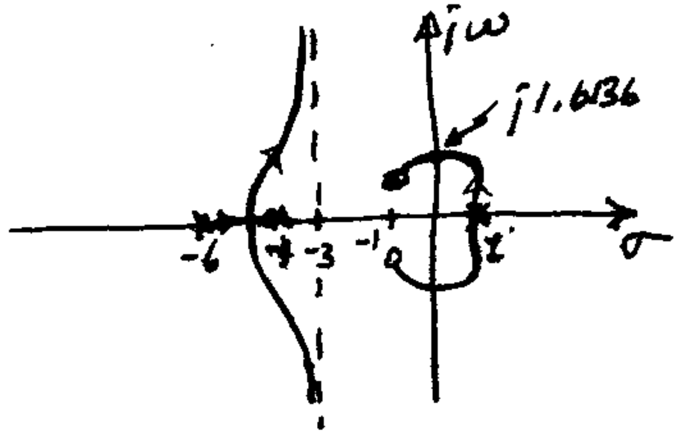
c)



d)



#2 a)



Breakaway from

$$(s-1)\Big[2(s+4)(s+6)(s^2+2s+2) + (s-1)(s+6)(s^2+2s+2) + (s-1)(s+4)(s^2+2s+2) - (s-1)(s+4)(s+6)(2s+2)\Big] = 0$$

b) $K > 29.452$

c) $K = 29.4152$

#3 $D(s) = 21.692 \dfrac{s+3.71}{s+4.85}$

#4 $D(s) = \dfrac{s+0.08}{s+0.02}$