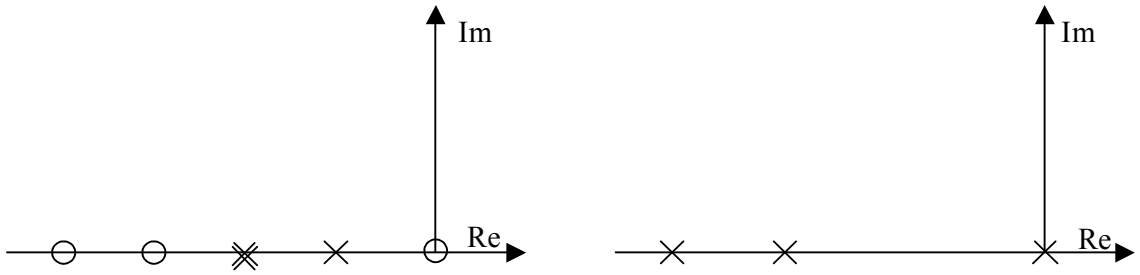
Arab Academy for Science and Technology & Maritime Transport
College of Engineering & Technology
Department : Electrical power and computer control
Course : Control System I **Course No:** EE 411
Lecturer : Prof. Dr. Hassan Ibrahim
TA : Eng.

Sheet (1)

1. For the pole-zero map given in fig (1) determine those segments of the real axis that satisfy the argument part of the characteristic equation.



Fig(1)

2. Sketch the Root Locus plots for the following closed loop systems with unity feed back and open loop T.F. of:

a) $KG(s) = K(s+1) / s^2 (1 +0.1s)$
b) $KG(s) = K(s + 1) / s (s^2 + 8s + 16)$
c) $KG(s) = K(s+12) / s (s^2 +16s + 100)$
d) $KG(s) = K / s (s^2 +2s + 2)(s^2 + 6s+10)$

3. Sketch the root locus for a feedback system having the following forward and feedback transfer functions

$KG(s) = K(s + 0.1) / s^2 (s + 0.01)$ $H(s) = 1+ 0.6 s$

4. A unity feed back system having an open loop T.F. of

$KG(s) = K / s (1+0.1 s) (1+ s)$

a) Sketch the root locus
b) What values of gain will make the C.L. system unstable
Find the gain K which corresponds to $\zeta = 0.5$

5. A unity feedback control system has the forward transfer function

$KG(s) = K / (s +1) (s + 2) (s + 5) (s + 6)$

a) Draw the root locus for the closed loop system
b) Find the gain K which corresponds to $\zeta = 0.5$

6. A feedback control system has an open loop T.F

$$GH(s) = \frac{k}{s(s+3)(s^2+2s+2)}$$

Find the root locus as k varied from 0 to ∞

7. Given the open loop T.F

$$GH(s) = \frac{k}{s(s+4)}$$

Plot the open loop poles on the complex plane and determine the segments of the real axis satisfying the angle equation. In which direction do the branches of the locus go to infinity?

8. For the open loop T.F

$$GH(s) = \frac{k}{s(s+5)(s+6)}$$

Find the points on the root locus that have a real part $\sigma = -2$ and the imaginary part $\omega = \pm 1$ calculate the gain at these locations

9. A system has an open loop T.F given by :

$$GH(s) = \frac{k}{(s+2+j2)(s+2-j2)}$$

a) Sketch its root locus

b) What is the angular frequency, the damping factor , the rise time , the settling time of that system when k = 10

c) The system gives a steady-state error which is proposed to eliminate by including in the forward path a block with T.F of $\frac{1}{s}$. What will now be the root locus diagram ?