University of Jordan
Elect. Eng. Dept.

Control Systems 93441 **Second Exam** **Tues. 1/8/1995**

1

a) Sketch the root locus given by $G(s)H(s) = \dfrac{K(s^2 - 4s + 8)}{(s^2 + 2s + 2)(s + 4)}$

If two roots on the locus are pure imaginary , outline how you would find the third root **graphically** . Formulate any equation needed without solving it .

b) For the unity feedback system with open loop transfer function as in part (a) :
Obtain **graphically** the closed loop unit step time response for the case where the closed loop poles are approximated by $\pm 2j$ and -6 at $k = k_c$.

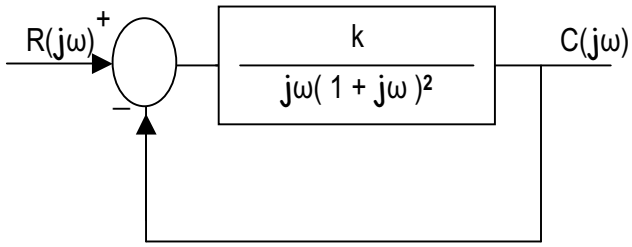
2

a) Sketch the asymptotic Bode diagram of $G(j\omega)$ as $\dfrac{(1 - \omega/4)}{j\omega(1 + j\omega/2)}$

Hence , find the gain margin **using the diagram .**

b) Given the system shown :

* For $k = 1$, plot the Nyquist diagram using the information at
$\omega = 0.8$ rad/sec and $\omega = 0.9$ rad/sec together with the information that
the gain margin is 2 and that
the phase margin is $90 - 2\tan^{-1} 0.7$.
Using graphical methods .



* Find the steady state time output $c(t)$ when $k = 1.4$ and when $k = 3$ and the input is $r(t) = 5\sin(\omega t)$.

* Find the value of k such that the maximum closed loop magnitude due to a unit sinusoid is 1.5 .
