1. The transfer function of an unknown plant is $a/(s+b)$. Please derive and explain how you can determine the parameters a and b through experiments for the following two cases (i) $a>0$ and $b>0$; (ii) $a>0$ and $b<0$. (14%)

2. Given the system shown in Figure 1, (18%)

   (i) determine the gain margin when the phase-crossover frequency $\omega_{\pi}<10$,

   (ii) determine the stability, and

   (iii) draw the Bode plot of the open-loop transfer function.

3. Determine the transfer function and the stability of the system shown in Figure 2. (15%)

4. For a unity feedback control system with impulse response $h(t)$,

   prove that $\frac{1}{K_v}=\int_0^{\infty} t\,h(t)\,dt$, and $\frac{1}{K_a}=-\frac{1}{2}\int_0^{\infty} t^2\,h(t)\,dt$,

   where K_v is the velocity-error constant and K_a is the acceleration-error constant. (15%)

5. Given a closed-loop system described by the transfer function, $\frac{C(z)}{R(z)}=\frac{z^2+0.3z+0.2}{z^2-z+0.9}$.

   (i) Express $c(k)$ as a function of $r(k)$, as a single difference equation.

   (ii) Find a set of state equations for this system.

   (iii) Calculate the transfer function from the results of part (ii), to verify these results. (18%)

6. (i) Please give the definition of the *well posed* for a composite system.

   (ii) Which of the systems in Figure 3 are well posed? (20%)

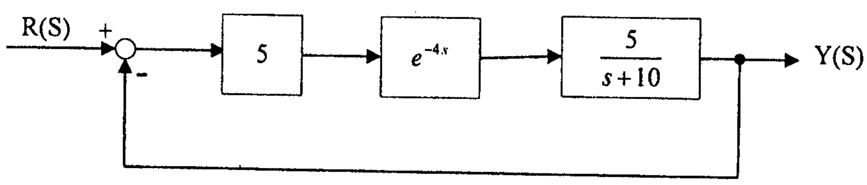

Figure 1

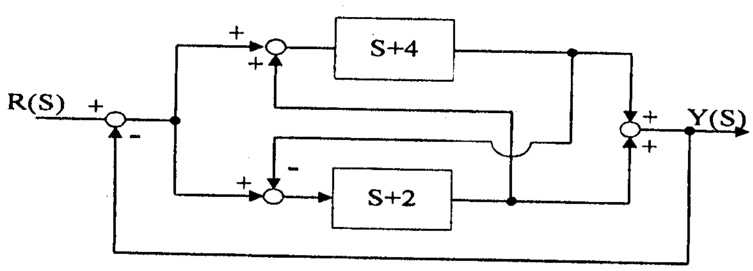

Figure 2

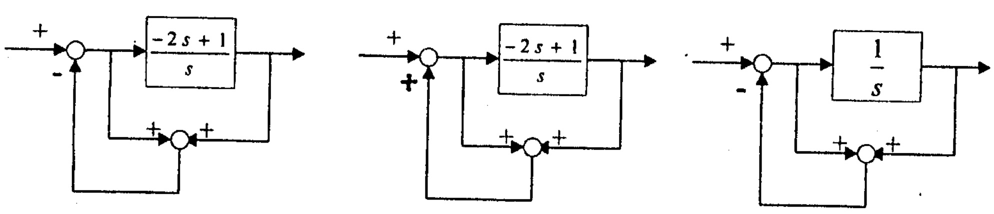

Figure 3