1) Large welding robots are used in today's auto plants. The welding head is moved to different positions on the auto body, and rapid, accurate response is required. A block diagram of such system is shown below. Find the range of $K$ and $a$ for which the system is stable.

2) The important objective of paper making process is to maintain uniform consistency of the stock output as it progresses to dry and roll up. A diagram of the thick stock consistency dilution control system is above. The amount of water determines consistency. $H(s) = 1, G_c(s) = Kc(s+1), G(s) = \frac{1}{s(s+1)}$.

$$T(s) = \frac{Y(s)}{R(s)} = ?$$

System type: ?

$\zeta_s = ?$ for $R(s) = \frac{1}{s}$.

Calculate $K$ for allowable steady-state error of 1%.

3) For a 2nd order system, characteristic equation poles are desired to be in the region of $\sigma > 0.7$, $\tau_s < 0.1$ sec and $\tau_p < 0.01$ sec. Find the corresponding region in complex plane.

4) $\frac{Y(s)}{R(s)} = ?$