1.

A control system is designed for the position control of a machine tool, as shown in Fig.1.

A PID-controller with three control parameters, K_P, K_I and K_D, is used to implement the position control.

(a) Derive the closed-loop transfer function. (10%)

(b) Decide the values of the control parameter K_P, K_I and K_D to satisfy the closed-loop conditions with (i) a real pole at -20, (ii) a damping ratio of $\varsigma = 0.6$ and (iii) an undamped natural frequency of $\omega_n = 5$ rad/sec. (15%)

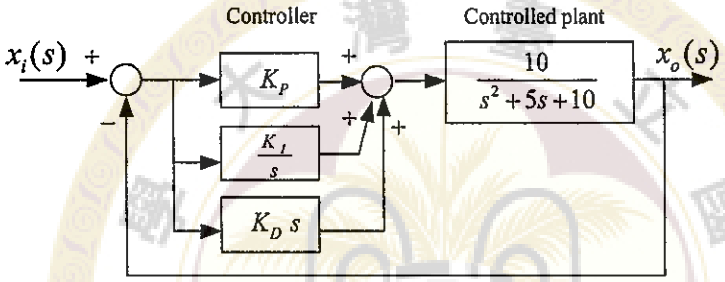

Fig.1

2.

An unity feedback control system with a PI-controller and an external disturbance D(s) is shown in Fig.2.

(a) Please find the system's type and discuss the steady state error, and also find the value of K_I that will result in the steady state error $e_{ss} = 10\%$. (10%)

(b) Using the value of K_I found in (a), please find the range of K_P for closed-loop stability. (10%)

(c) Please use the Final Value Theorem to find the steady state error e_{ss} for a step disturbance input $D(s)$ as $K_I \neq 0$. (10%)

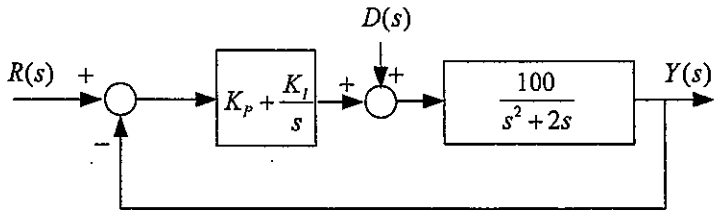

Fig.2

見背面

3.

The control system of a mobile robot can be described in Fig.3, where K_1 and K_2 are feedback gains.

(a) Please derive the state-space model for the closed-loop system, $\dot{\mathbf{X}} = \mathbf{AX} + \mathbf{B}r$, $y = \mathbf{CX}$. The state variables x_1 and x_2 are defined in Fig.3. (10%)

(b) Please solve the feedback gains K_1 and K_2 to yield the two closed-loop poles at $-10 \pm j10$. (10%)

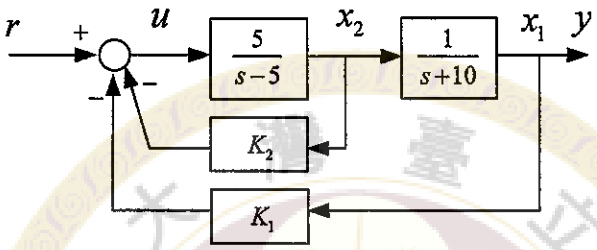

Fig.3

4.

Consider an unity feedback control system with time delay of a hydraulic servo control system as shown in Fig.4.

(a) Please find the gain crossover frequency. (10%)

(b) Please derive the phase margin. (10%)

(c) Discuss the range of the time delay T for keeping the closed-loop system stable. (5%)

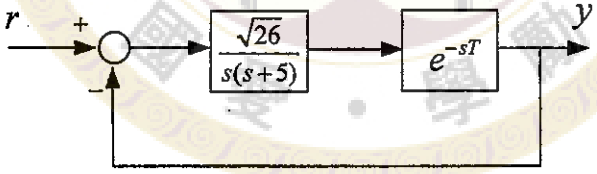

Fig.4

試題隨卷繳回