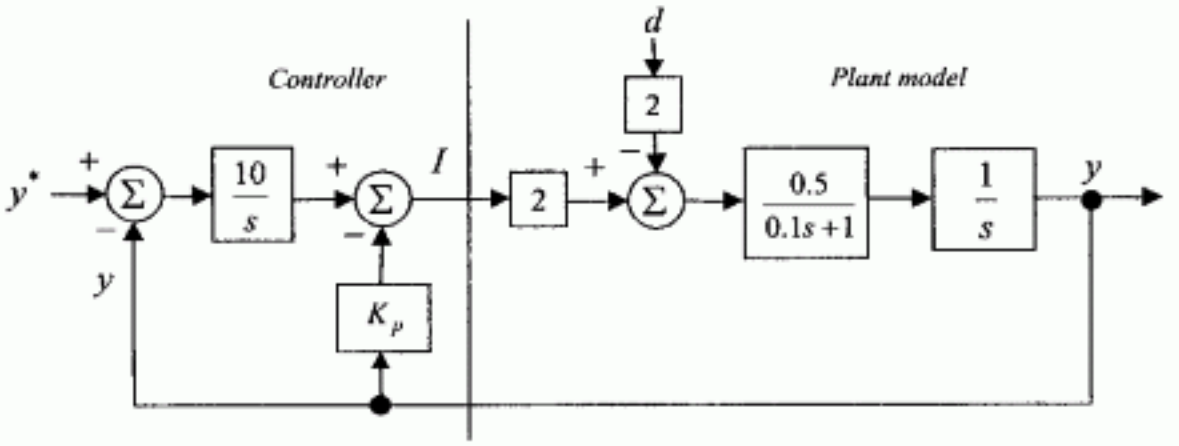
國　立　清　華　大　學　命　題　紙

九十三學年度 電機工程學 系（所） 乙 組碩士班入學考試

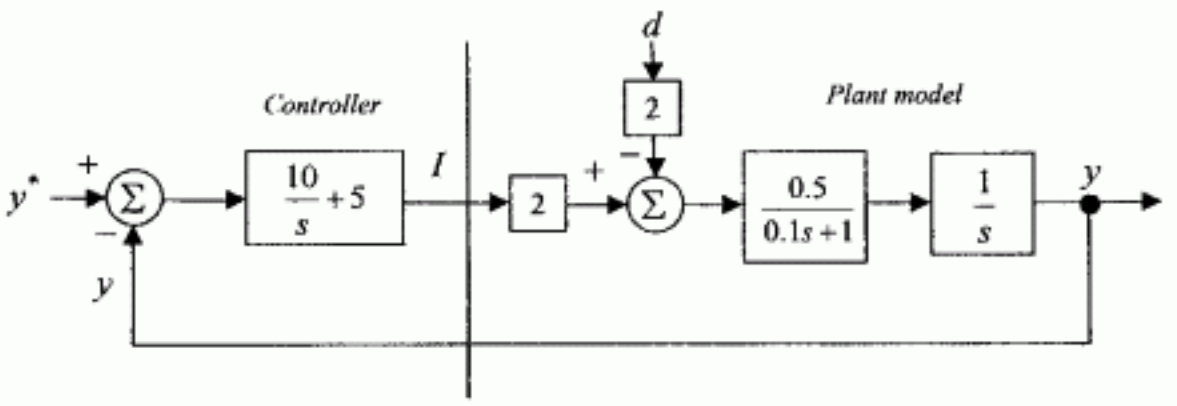
科目 控制系統 科號 2705 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

1. For the control system as shown answer the following questions: (30%)

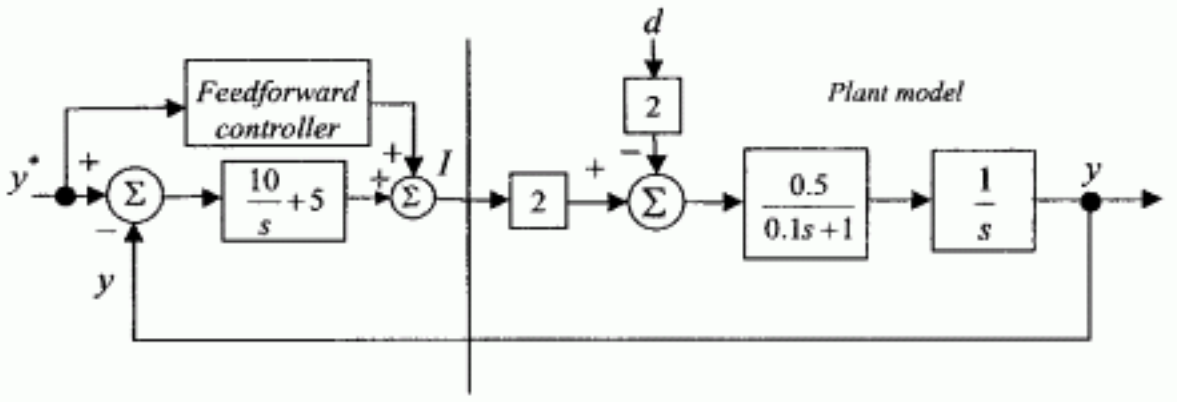
(1) Find the range of $K_p$ for the closed-loop system to be stable.
(2) If the closed-loop poles are assigned at $-3 \pm j4$ and $-4$, find the value of $K_p$.
(3) If $K_p = 5$ is set, find the steady-state values of output due to: (a) unit-step command change; (b) unit-ramp command change; (c) unit-step disturbance change.



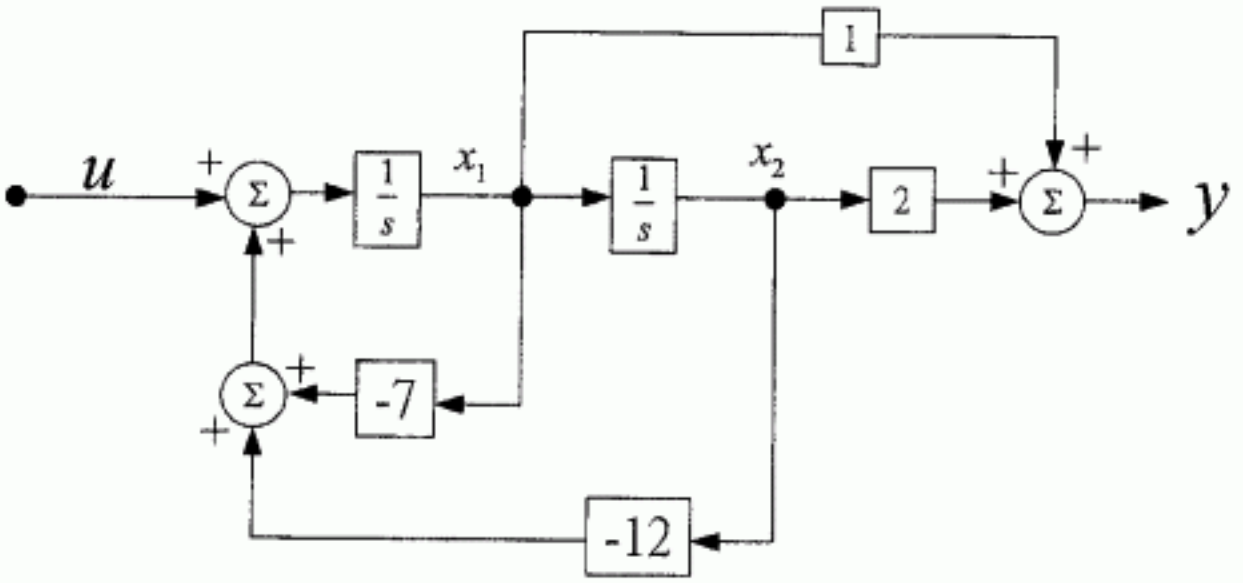

(4). (a) If the above controller is changed to the following configuration, find the transfer function from $I$ to $y^*$, i.e., $H_{yI}(s) \triangleq I(s)/y^*(s)\big|_{d(s)=0}$; (b) Find the value of $I(t)$ at $t=0$ due to unit-step command change.




(5). Find the following feedforward controller to yield ideal tracking control.



2.




In the above system, please answer the following question.

(1) Please write down the following state space equation. (10%)

$$\dot{\mathbf{x}} = A\mathbf{x} + B\mathbf{u}$$

$$y = C\mathbf{x}$$

(2) Please design a state feedback control law so that all the eigenvalues of feedback system are all at –1. (10%)

(3) Please design a state estimator from the output $y$ so that all the eigenvalues of state estimator are all at –3. (10%)

**3.** **(a)** State Nyquist stability criterion.

**(b)** Indicate how you would prove such a criterion.

**(c)** Define gain margin and phase margin by using the Nyquist plot of a second order system $G(s)=\dfrac{K}{(s+a)(s+b)}$, where $a>b>0$. **(20%)**

**4.** (a) State Bode's gain-phase relationship

(b) State how can you use this relationship to design a system that will have acceptable phase margin. **(20%)**