國立臺灣科技大學103學年度碩士班招生試題

系所組別： 電機工程系碩士班丁二組

科　　目： 控制系統與數位邏輯

（總分為100分）

Problem 1: (15 points)

Let signals $x(t)=\begin{cases}\sin t & 0\le t\le \pi\\ 0 & \text{otherwise}\end{cases}$ and $h(t)=\begin{cases}\cos t & 0\le t\le \pi\\ 0 & \text{otherwise}\end{cases}$,

(a) compute the convolution signal $y(t)=x(t)*h(t)=\int_{-\infty}^{\infty}x(\tau)h(t-\tau)d\tau$, $-\infty<t<\infty$.

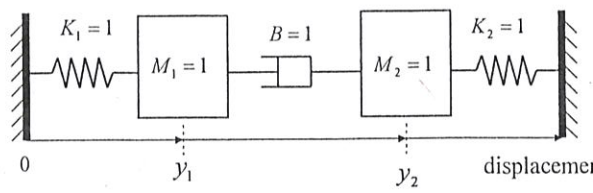
(10 points)

(b) Plot the signal $y(t)$, $-\infty<t<\infty$. (5 points)

Problem 2: (15 points)

Given the mass-spring-damper mechanical system as shown below, in which y_1 and y_2 are the displacement of mass 1 and mass 2, respectively;

(a) find out the state-space representation of the system $\dot{x}=Ax$, where the state variables $x=[x_1 \quad x_2 \quad x_3 \quad x_4]^T=[y_1 \quad y_2 \quad \dot{y}_1 \quad \dot{y}_2]^T$. (10 points)

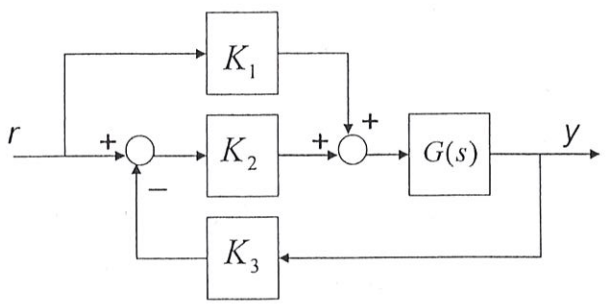


(b) Determine whether the system is asymptotically stable, marginally stable or unstable, why and why not? (5 points)

Problem 3: (20 points)

Consider the following feedback control system, where $G(s)=\dfrac{s}{s^2+4}$,

(a) draw the root locus of the system for $0\le K_1<\infty$ and $K_2=K_3=1$. (5 points)



(b) Draw the root locus of the system for $0\le K_2<\infty$ and $K_1=K_3=1$. (5 points)

(c) Plot the curve of phase margin v.s. K_3, $0<K_3^*<\infty$ and $K_1=K_2=1$. (5 points)

(d) What are the differences of the roles of K_1, K_2 and K_3 in system transfer functions and stability? (5 points)

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Problem 4: (10 points)

Implement $F = wx' + y'z' + w'yz'$ with two-level NOR gate circuit.

Problem 5: (20 points)

A sequential circuit with two D flip-flops A and B, two inputs x and y, and one output z is specified by the following next-state equations: $A(t+1) = x'y + xB$, $B(t+1) = x'A + xB$, and output equation: $z = A$.

(a) Draw the logic diagram of the circuit (6 points).

(b) List state table for this sequential circuit (7 points).

(c) Draw the corresponding state diagram (7 points).

Problem 6: (20 points)

Design a counter with T-flip-flops that goes through the following binary repeated sequence: 0, 1, 3, 7, 6, 4. Show that when binary states 010 and 101 are taken to be don't-care conditions, the counter may not operate properly. Find a way to correct the design.