總分 100 分

1. Stability is the most important system specification. Please explain the following problems about stability:
   (a) Please explain the natural response definition of stability. (5%)
   (b) Please explain the BIBO definition of stability. (5%)
   (c) In the unity feedback system of Fig.1 with $G(s)=\dfrac{1}{4s^2(s^2+1)}$, please use the Routh-Hurwitz criterion to discuss the locations of the the closed-loop poles in the s-plane. (10%)

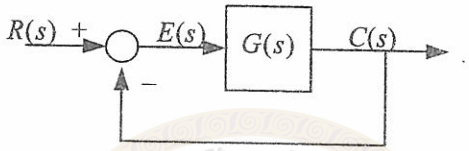
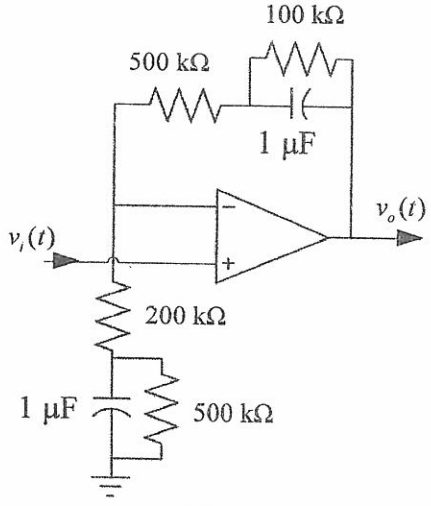


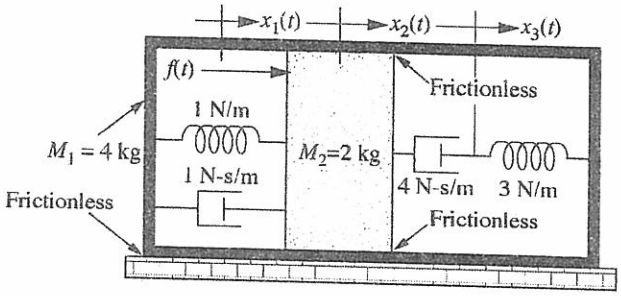
Fig.1

2.
Please clarify the following important problems of automatic control:
(a) Please explain the following terms using a differential equation:
   (i) linear and nonlinear (4%)
   (ii) time-invariant and time-variant (4%)
   (iii) causal and noncausal (4%)
(b) What kind of systems is discussed in automation control. (4%)
(c) Please explain the difference of the initial conditions between transfer function and state equation. (4%)

3. Find the transfer function of the following systems:
(a) $G(s)=V_o(s)/V_i(s)$ (10%)　　(b) $G(s)=X_3(s)/F(s)$ (10%)



(a)



(b)

Fig.2

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4. A control system is shown in Fig.3.

where $D(s)=\dfrac{s+a}{s+8}$ and $G(s)=\dfrac{10}{s(s+1)}$

(a) Sketch the root locus plot. (10%)

(b) Determine the value of a such that the damping ratio of the dominant poles is $\varsigma=0.5$. (10%)

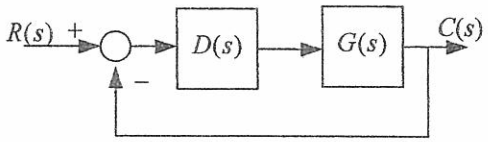

Fig.3

5. A unity-feedback system is shown in Fig.3 with $G(s)=\dfrac{1}{s(s+2)}$

(a) Please design a phase-lead compensator $D(s)=\beta\dfrac{1+\alpha Ts}{1+Ts}$ to make the loop transfer function $D(s)K(s)$ satisfy the following conditions: (i) velocity constant=10; (ii) phase margin=60° ; (iii) gain margin ≥ 12 dB. (15%)

(b) If a phase-lag compensator is designed for the same system and conditions as (a), please explain the differences between the phase-lead compensated and the phase-lag compensated systems. (5%)

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