大同大學 100 學年度研究所碩士班入學考試試題

考試科目:自動控制　　所別:機械工程研究所　　

註:本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 可以使用計算器。

(15%)(1) For a state variable equation

$$\dot{\mathbf{x}}=\begin{bmatrix}-3 & -2 & -1\\ 1 & 0 & -1\\ 0 & 0 & -4\end{bmatrix}\mathbf{x}+\begin{bmatrix}1\\0\\0\end{bmatrix}u(t)$$

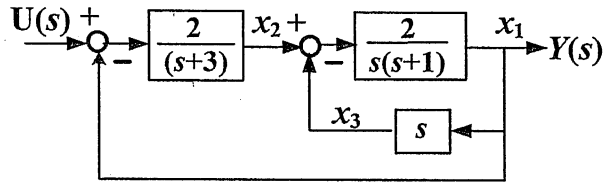
$$y=[1\quad 2\quad 3]\mathbf{x}$$

(*a*) Find the transition matrix $\phi(t)$.

(*b*) If $\mathbf{x}(0)=[0\ 0\ 0]^T$, $u(t)=\delta(t)$, Find $\mathbf{y}(t)$

(*c*)Determine the transfer function $Y(s)/U(s)$.

(10%)(2) For the block diagram shown in Fig. 2,



Using the defined state variables x_1, x_2, and x_3, find its state space equation $\dot{\mathbf{x}}=\mathbf{A}\mathbf{x}+\mathbf{B}u$; $\mathbf{y}=\mathbf{C}\mathbf{x}$

(10%)(3) For the state-variable equation

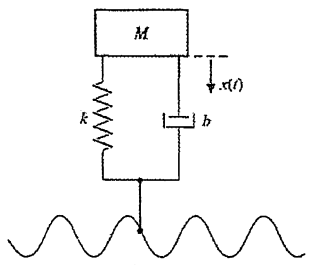
$$\dot{\mathbf{x}}=\begin{bmatrix}3 & 1 & 0 & 0 & 0\\ 0 & 3 & 1 & 0 & 0\\ 0 & 0 & 3 & 0 & 0\\ 0 & 0 & 0 & 5 & 0\\ 0 & 0 & 0 & 0 & 1\end{bmatrix}\mathbf{x}+\begin{bmatrix}0\\0\\1\\1\\1\end{bmatrix}u$$

$$\mathbf{y}=[1\quad -2\quad 2\quad 3\quad 4]\mathbf{x}$$

$-\lambda^3-7\lambda^2-14\lambda-8$

Find the transfer function $Y(s)/U(s)$

(15%)(4) As an automobile moves along the road, the vertical displacements at the tires act as the motion excitation to the automobile suspension system. The figure shown is a schematic diagram of a simplified automobile suspension system, for which we assume the input is sinusoidal. Determine the transfer function X(s)/R(s), and sketch the Bode diagram when M=1 kg, b = 4 N s/m, and k = 18 N/m.



(15%)(5) (a) Find a suitable contour Γ_s in the s-plane that can be used to determine whether all roots of the characteristic equation have damping ratios greater than ζ_1,

(b) Find a suitable contour Γ_s in the s-plane that can be used to determine whether all the roots of the characteristic equation have real parts less than $s=-\sigma_1$.

(c) Using the contour of part (b) and Cauchy's theorem, determine whether the following characteristic equation has roots with real parts less than s=-1: $q(s)=s^3+11s^2+56s+96$.

<背面繼續>

<接前頁>

(20%)(6) Draw a typical unit step response of a linear system. Show the following properties on the respose curve and describe the definitions: (1)Maximum overshoot; (2)Delay time; (3)Rise time;(4)Settling time

(15%)(7) How to decide the stability of a linear system? (Please give two of the methods at least.)