淡江大學八十七學年度碩士班入學考試試題

系別： 機械工程學系　　科目： 自動控制

本試題共 2 頁

1. **(30%)** A lathe(車床) has a cross-slide whose position is to be automatically controlled to follow a parabolic cutting profile of the form $y_0+y_1t+1/2\,y_2\,t^2$ with cutting time. Assume proportional, derivative and integrating control actions are to be employed and that the cross-slide has mass m and can be represented as a double integration plant.
   (a) *(5%)* Find the Laplace transform of $y_0+y_1t+1/2\,y_2\,t^2$.
   (b) *(10%)* Draw a block diagram of the system.
   (c) *(10%)* Derive its closed loop transfer function.
   (d) *(5%)* Determine the steady state error of the cross-slide position as it follows the reference input cutting profile.

2. **(15%)** Sketch the root loci for the closed-loop control system with
   $G(s) = \dfrac{K}{s(s+1)(s^2+4s+5)}$, $H(s) = 1$

3. **(15%)** Prove that the polar plot of the transfer function $G(s) = \dfrac{sT}{1+sT}$ is a semicircle. Find the center and radius of the circle.

4. **(15%)** Figure 1 shows the block diagram of a motor control system with tachometer feedback. Find the range of the tachometer constant K_t so that the system is asymptotically stable.

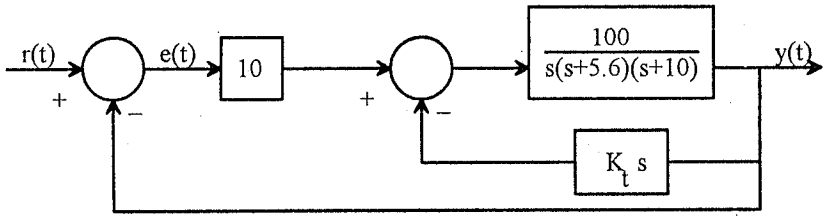

Figure 1

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5. **(25%)** Figure 2 shows the diagram of a printwheel system with belts and pulleys. The belts are modeled as linear springs with spring constants K_1 and K_2. $T_m(t)$ is the motor torque, $\theta_m(t)$ the motor displacement, $y(t)$ the linear displacement of the printwheel, J_m the motor inertia, B_m the motor viscous-friction coefficient, r the pulley radius, and M the mass of the printwheel.
(a) *(10%)* Write the differential equations of the system using θ_m and y as the dependent variables.
(b) *(10%)* Write the state equations using $x_1=r\theta_m-y$, $x_2=dy/dt$, and $x_3=\omega_m=d\theta_m/dt$ as the state variables.
(c) *(5%)* Draw a state diagram for the system.

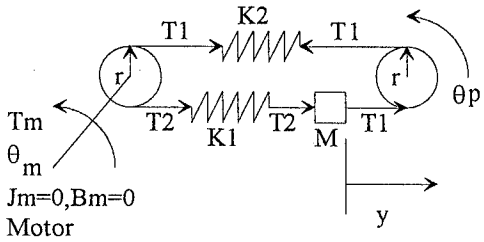

Figure 2