



Islamic University of Gaza
Electrical Engineering Department
EELE 3360 Control Systems
Final Exam
June, 4, 2011

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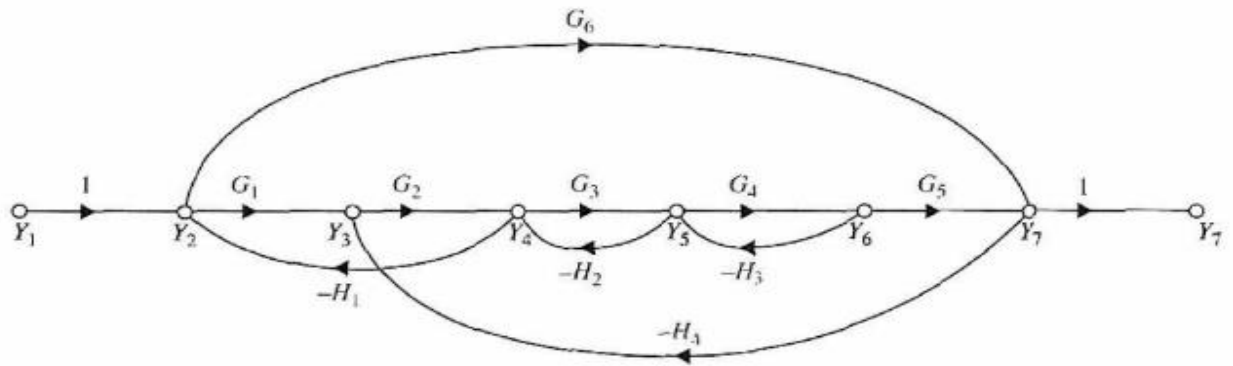
Exam Time 1:00-3:00

Name	
Student ID	
Grade	

GOOD Luck

1. a) Find the transfer functions Y_7/Y_1 .

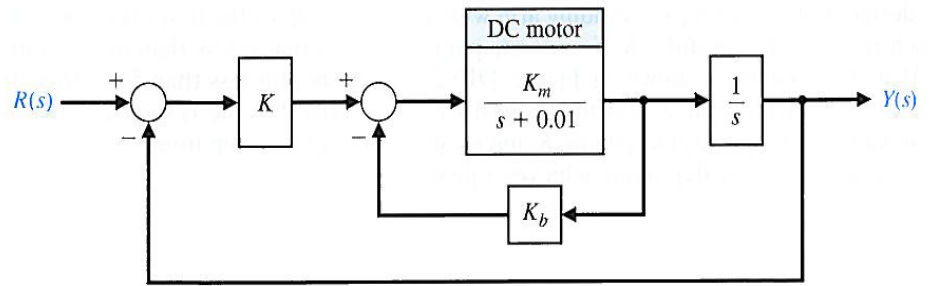
(7 PT.)



1. b) In the system shown in the Fig. below; Plot the response to unit step input

(8 PT)

$$K_m = 10, K_b = 0.05, K = 0.051$$



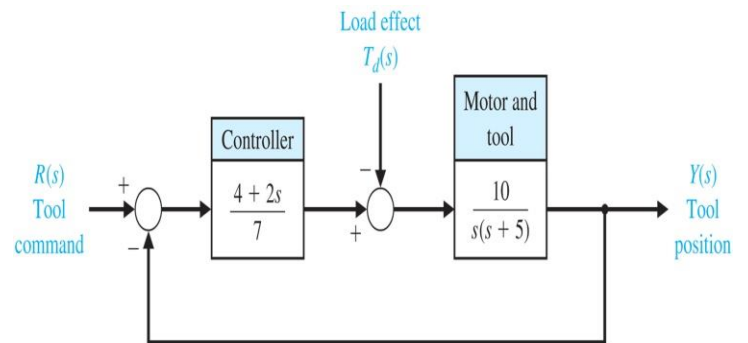
2. A machine tool is designed to follow a desired path so that

$$r(t) = (1-t) u(t)$$

The machine tool control system is shown in the Figure below.

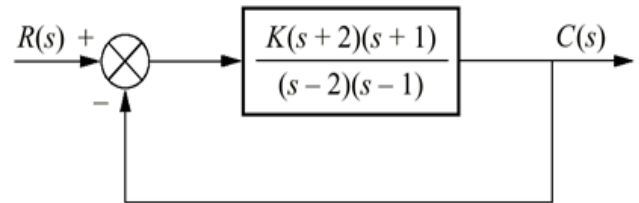
i. Determine the steady-state error when $r(t)$ is the desired path as given and $T_d(s)=0$ (5 PT.)

ii. If the desired input is $r(t) = 0$, find the steady state error when $T_d(t)$ is unit step (5 PT.)



3. For the system shown in the Figure below, do the following:

- i. Sketch the root locus. (5 PT)
- ii. Find the $j\omega$ -axis crossing and the gain, k , at the crossing. (3 PT)
- iii. The value of K that yield a stable system with a pair of second order poles have $\zeta=0.707$, $T_s=4$ sec. (3 PT)



4. a) **Diagonalize the following system:**

(5 PT)

$$\dot{\underline{X}} = \begin{bmatrix} -5 & -5 & 4 \\ 2 & 0 & -2 \\ 0 & -2 & -1 \end{bmatrix} \underline{X} + \begin{bmatrix} -1 \\ 2 \\ -2 \end{bmatrix} r(t)$$

$$y = [-1 \quad 1 \quad 2] \underline{X}$$

4. b) Consider the following mechanical system where $T(t)$ is applied torque; $TB1 = 10\dot{\theta} + \theta^3$ and $TB2 = 5\dot{\theta}$ are damping force; $K=20$ and $J=2$ are spring stiffness and inertia
- Find the mechanical system differential equation. (3 PT)
 - Linearize the above nonlinear system at $\theta_0 = 0$, $\dot{\theta}_0 = 1$, $\ddot{\theta}_0 = 0$ (3 PT)
 - Find the Linearize transfer function. (3 PT)

