



Islamic University of Gaza
Electrical Engineering Department
EELE 3360 Control Systems
Final Exam
June 17, 2026

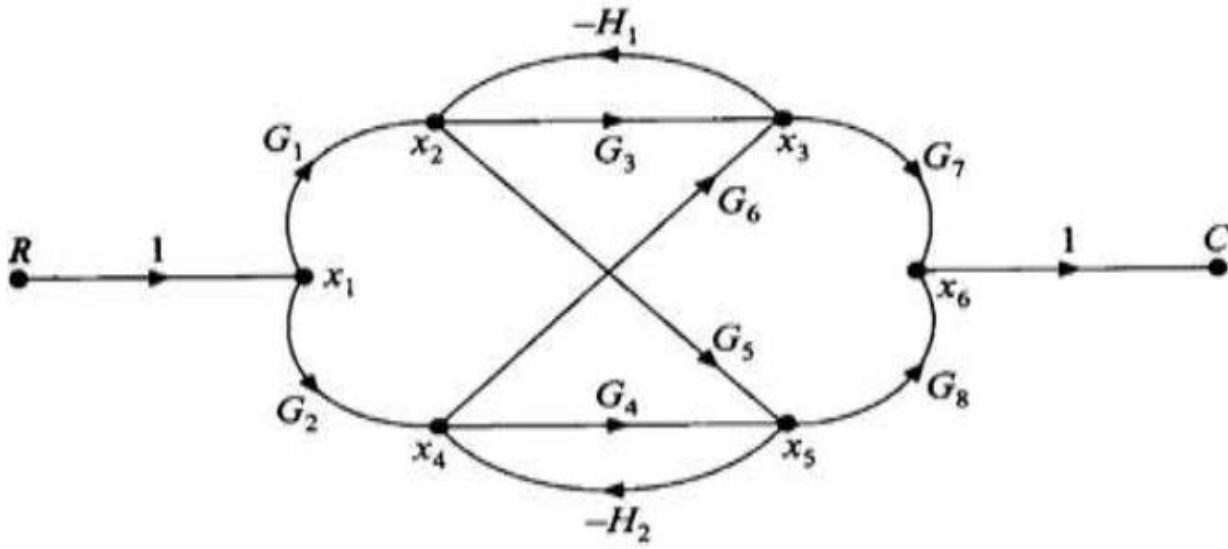
Dr. Basil Hamed

Exam Time: 1:00-4:00

Name	
Student ID	
Grade	

GOOD Luck

1. For system given in Figure, find Transfer Function using Mason Gain Formula. $T(s) = C(s)/R(s)$ (10 PT)



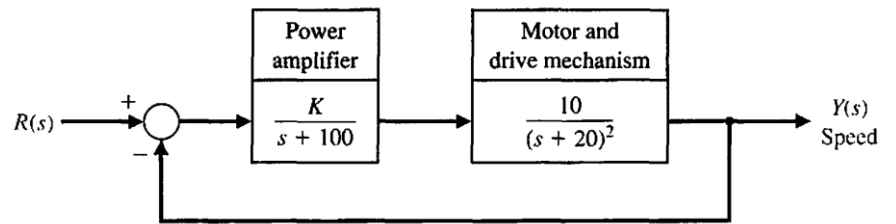
2. For system given in Figure below, find;

(a) The limiting gain for a stable system.

(6 PT.)

(b) A suitable gain so that the overshoot to a step command is approximately 5%.

(4 PT.)

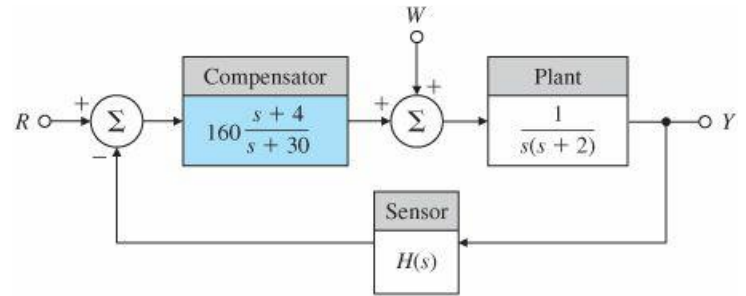


3. The model of system is shown below

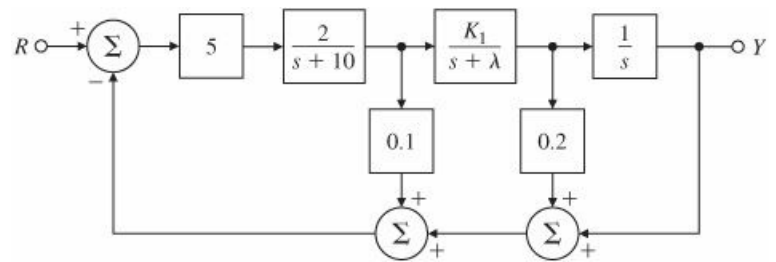
(a) Can the system track a step reference input **R** with zero steady-state error? If yes, give the value of the velocity constant. (3 PT.)

(b) Can the system reject a step disturbance **W** with zero steady-state error? If yes, give the value of the velocity constant. (3 PT.)

(c) In some instances, there are dynamics in the sensor. Repeat parts (a) and (b) for $H(s) = \frac{20}{s+20}$ and compare the corresponding velocity constants. (4 PT.)



4. (a) For the system given in Fig. below, plot the root locus of the characteristic equation as the parameter K_I is varied from 0 to ∞ with $\lambda = 2$. (5 PT.)
- (b) Repeat part (a) for fixed $K_I = 2$, with the parameter $K = \lambda$ varying from 0 to ∞ . (5 PT.)



5. a) The equations of motion for the DC motor is given:

$$J_m \ddot{\theta}_m + \left(b + \frac{K_t K_e}{R_a} \right) \dot{\theta}_m = \frac{K_t}{R_a} v_a.$$

Assume that

$J_m = 0.01 \text{ kg.m}^2$, $b = 0.001 \text{ N.m.sec}$, $K_e = 0.02 \text{ V.sec}$, $K_t = 0.02 \text{ N.m/A}$, $R_a = 10 \Omega$

- (i) Find the transfer function between the applied voltage v_a and the shaft angle θ_m . (3 PT.)
- (ii) Suppose feedback is added to the system in part (i) so that it becomes a position servo device such that the applied voltage is given by $v_a = K(\theta_r - \theta_m)$, where K is the feedback gain. Find the transfer function between θ_r and θ_m . (3 PT.)
- (iii) What is the maximum value of K that can be used if an overshoot $M_p < 20\%$ is desired? (3 PT.)
- (iv) What values of K will provide a rise time of less than 4 sec? (Ignore the M_p constraint.) (3 PT.)

5. b) A system has a block diagram as shown in Figure below. Determine a state variable model and the state transition matrix $\phi(s)$. (8 PT)

