Model Exam

1. Explain the operation of the speed control system shown in Figure (1). Also a) draw block diagram for this system. b) transfer function Y(s)/E(s)

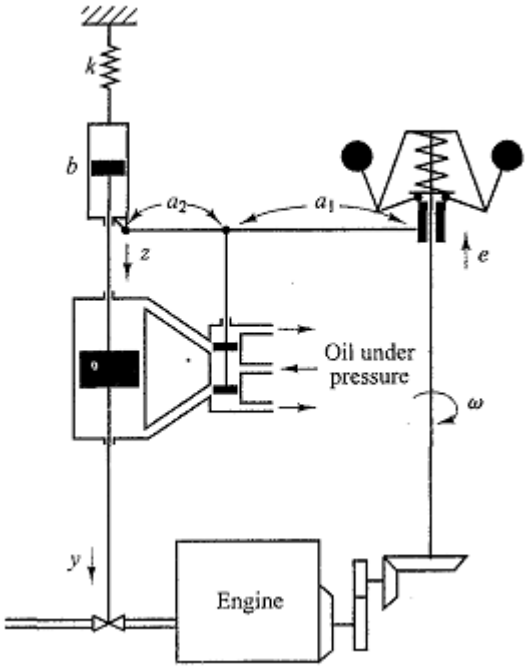

Fig. 1. Speed control system.

2. Consider a unity-feedback control system with the closed-loop transfer function Determine the open-loop transfer function G(s). $\frac{C(s)}{R(s)} = \frac{Ks + b}{s^2 + as + b}$

Show that the steady-state error in the unit-ramp response is given by

$$e_{ss} = \frac{1}{K_v} = \frac{a - K}{b}$$

3. Consider a unity-feedback control system whose open-loop transfer function is

$$G(s) = \frac{K}{s(Js + B)}$$

Discuss the effects that varying the values of K and B has on the steady-state error in unit-ramp response. Sketch typical unit-ramp response curves for a small value, medium value, and large value of K, assuming that B is constant

4. Consider the closed-loop system shown in Figure (3). Determine the range of K for stability. Assume that K > 0. Determine the sustained frequency for given system.

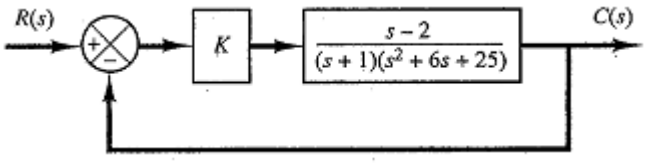

Fig.3. Control system

5. Explain the operation of the speed control system shown in Figure (4). Also Obtain the transfer function between the motor shaft angular displacement θ and the error voltage e_v. Obtain also a block diagram for this system and a simplified block diagram when La is negligible

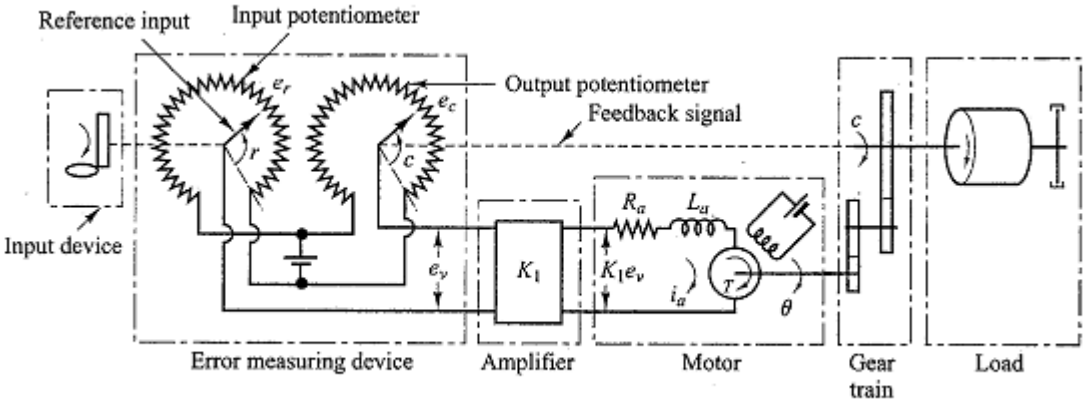

Fig. 4. Feedback system

6. Consider the servo system with tachometer feedback shown in Figure (5). Obtain the error signal E (s) when both the reference input R (s) and disturbance input D (s) are present. Obtain also the steady-state error when the system is subjected to a reference input (unit-ramp input) and disturbance input (step input of magnitude d). The damping ratio of this system is 0.158 and the undamped natural frequency is 3.16 rad/sec. Determine the value of K_h

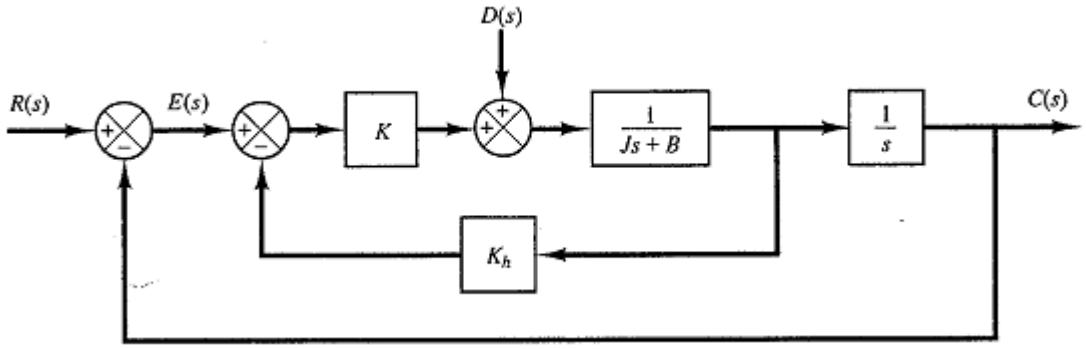

Fig. 6. Feedback system